Michigan Connected Vehicle Working Group Meeting Packet

May 2, 2011

1. **Agenda**
2. **Attendance List**
3. **Presentations**

MICHIGAN CONNECTED VEHICLE WORKING GROUP

Monday, May 2, 2011
Connected Vehicle Proving Center
University of Michigan-Dearborn
Institute for Advanced Vehicle Systems
4901 Evergreen Road
Dearborn, MI. 48128

MEETING AGENDA

(1) Welcome and Introductions (9:00-9:15 AM minutes)

(2) USDOT V2V Safety Pilot, Jim Sayer of UMTRI (9:15 to 9:30 AM)

(3) Briefing on the Crash Avoidance Metrics Partnership's V2V Activities by CAMP representative Mike Shulman of Ford (9:30 to 10:00 AM)

(4) 2014 ITS World Congress

- Update from Jim Barbaresso of HNTB (10:00 to 10:10 AM)
- Brainstorming Session led by Steve Kuciemba of PB (10:10 to 10:25 AM)

BREAK

(5) Update on the USDOT Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) Infrastructure Technology Test Bed, Taso Zografos of SAIC (10:35 to 10:45 AM)

(6) Update on CAR connected vehicle studies, Richard Wallace (10:45 to 10:55 AM)

(7) Regulation & Deployment, Paul Laurenza of Dykema Gossett PLLC (10:55 AM to 11:30 AM)

(8) Preview of Upcoming Federal Procurements and Discussion of Michigan Responses, Steve Cook of MDOT (11:30 to 11:45 AM)

(9) Tour of the CVPC (11:45 AM to noon)

MICHIGAN CONNECTED VEHICLE WORKING GROUP

MAY 2, 2011

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Michigan Connected Vehicle Working Group Presentations

May 2, 2011

Michigan
Connected Vehicle Working Group

Connected Vehicle Proving Center

University of Michigan-Dearborn

May 2, 2011

Agenda for This Morning

1. Welcome and Introductions
2. V2V Safety Pilot (Jim Sayer, UMTRI)
3. CAMP's V2V Activities (Mike Shulman, Ford)
4. 2014 ITS World Congress
   - Jim Barbaresso (ITS MI and HNTB)
   - Steve Kuciemba (PB)
5. USDOT V2V and V2I Test Bed (Taso Zografos, SAIC)
6. Connected Vehicle Studies (Richard Wallace, CAR)
7. Regulation and Deployment (Paul Laurenza, Dykema Gossett PLLC)
8. Upcoming federal procurements (Steve Cook, MDOT)
9. CVPC Tour (Steve Underwood, UM-D)

Working Group Mission

- Cooperatively pursue projects and other activities that are best accomplished through partnerships between multiple agencies, companies, universities, and other organizations and that ultimately advance Michigan's leadership position in connected vehicle research, deployment, and operations.
  - Benefit our state and our industry (automotive and more)
  - Enhance safety and mobility in Michigan and beyond

Since Last Meeting (December 2010)

- New year, new governor, new name (no more IntelliDrive)
- Director Steudle reappointed
- V2V Safety Pilot RFP released and responses submitted
- Connected Vehicle Technology Challenge came and went (submittal period over anyway)
- ITS Video Challenge underway (through June 30, 2011)
  - http://www.its.dot.gov/video_challenge/challenge.htm
- Connected Vehicle Core System CONOPS meeting set
  - May 17, 2011, Detroit Metro Airport Marriott
  - http://www.its.dot.gov/press/2011/core_system_walkthrough.htm
- ITS Michigan Annual Meeting set for June 1, 2011
- DRIC is now NITC (but still contentious)

Connected Vehicle Safety Pilot Model Deployment RFP

Jim Sayer
Proposed Michigan Team Program Manager

University of Michigan
Transportation Research Institute

Background Information

- US DOT RFP for Connected Vehicles Test Conductor
  - Released on 2/14
  - Proposals were due 4/14
- Summary of Role:
  - Conduct the most of the model deployment
  - Collect the most of the data
  - Support CAMP in driver recruitment
  - Support Volpe in data collection

Scope – Stages

- Pre-Model Deployment
  - Test interoperability and road-side equip (RSE)
- Model Deployment
  - 10 to 12 months
- Post-Model Deployment Evaluation
  - Independent Evaluator (Volpe Center)

Scope – Vehicles/Devices

- Vehicles (2500 – 3000)
  - Light vehicles (64 CAMP integrated vehicles)
  - Heavy trucks (required)
  - Transit vehicles (required)
- Devices
  - Here-I-Am devices
  - Aftermarket safety device (TBD systems)
  - Retrofit safety device (TBD systems)
  - Integrated (safety) device

Scope - Infrastructure

- RSE, signal controllers and data backhaul
  - 12 traffic signal controllers capable of transmitting SPaT data to an RSE. On two traffic corridors,
  - Curve Speed at three locations,
  - Actuated Traffic Signal Controller at 5 location
- Installation and maintenance of all hardware by the local traffic agency

Michigan Partners

Government Agencies

- Michigan DOT
- City of Ann Arbor
- Washtenaw County
- Washtenaw County Road Commission
- Washtenaw Area Transportation Study

University Entities

- UMTRI
- UM Parking and Transportation Services
- UM Health System
- Civil Engineering

Michigan Partners

Vehicle Fleets

- AATA
- UM Transportation Services
- Con-way Freight
- Ann Arbor Police Department
- Metro Delivery

Transportation Planners

- Parsons Brinckerhoff
- Mixon-Hill
- HNTB
- SAIC

Vehicle-to-Vehicle and Vehicle-to-Infrastructure Safety Communications

Michael Shulman

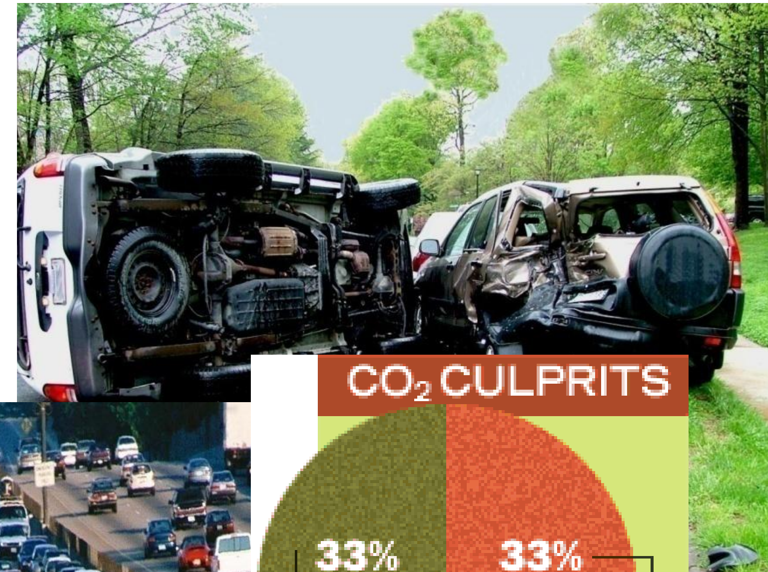
Active Safety Research and Advanced Engineering

Ford Motor Company

The Problem!!!

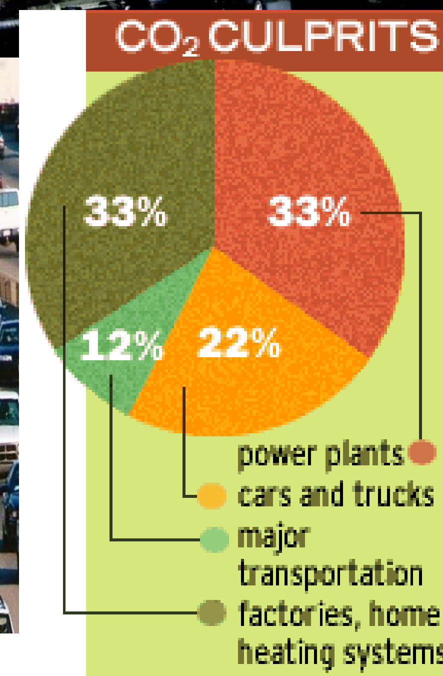
Safety

- 33,963 deaths/year (2009)
- 5,800,000 crashes/year
- **Leading cause of death for ages 4 to 34**



Mobility

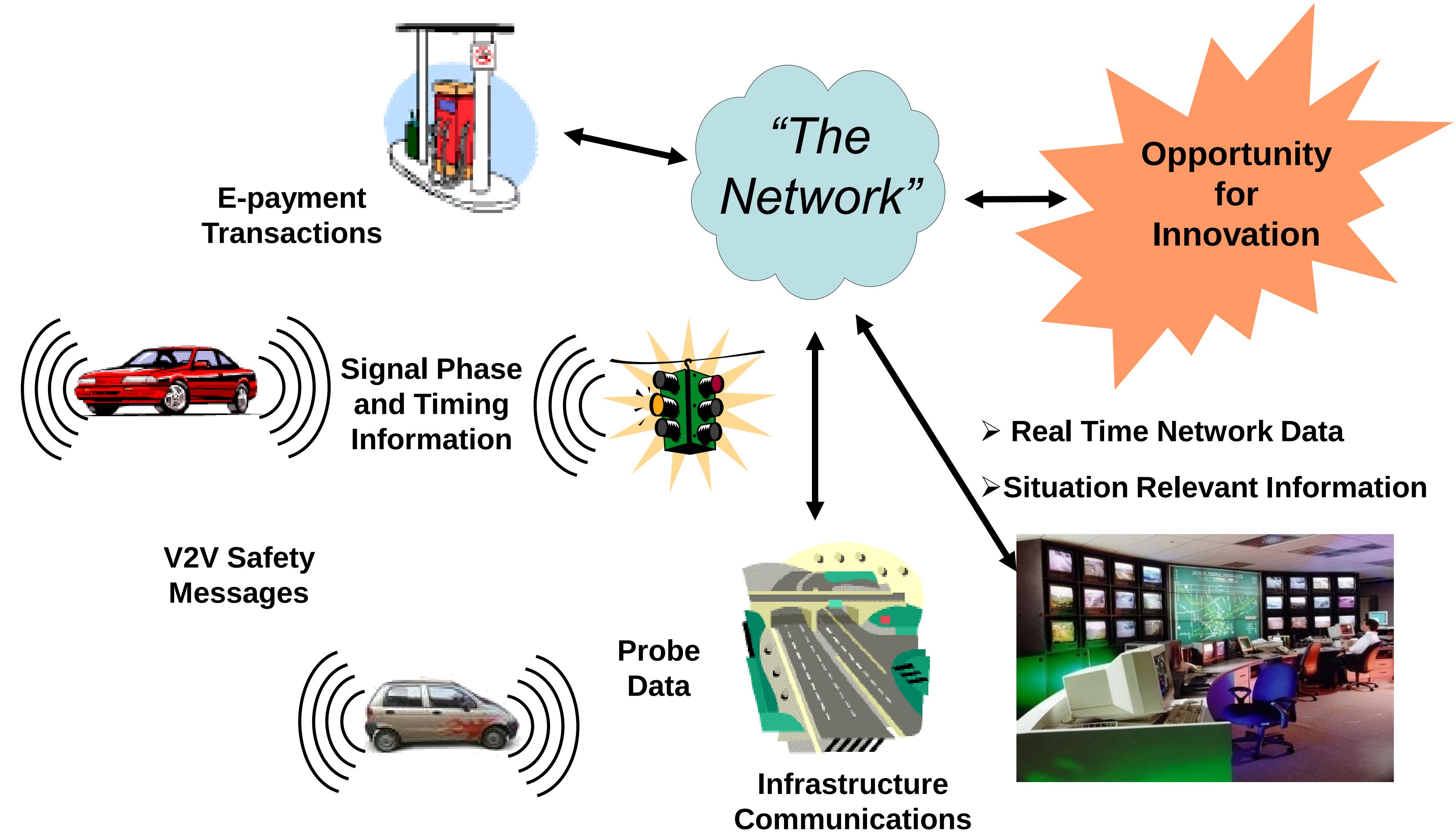
- 4.2 billion hours of travel delay
- $78 billion cost of urban congestion



Environment

- 2.9 billion gallons of wasted fuel

It's All About Connectivity



Evolution of IntelliDrive

Original VII Deployment Model

- DSRC based for all applications
  - Infrastructure intensive using new DSRC technology
  - Vehicle turnover for embedded DSRC technology
- Start with V2I (for all application types) and evolve into V2V (safety)

US DOT's Current Perspective on IntelliDrive Deployment

- Non-safety (mobility, environment)
  - Leverage existing data sources & communications; include DSRC as it becomes available
  - Support development of key applications for public agencies using current data sources
- Safety → DSRC
  - Aggressively pursue V2V; leverage vehicle capability for V2I spot safety
  - Can leveraging of nomadic devices & retrofitting accelerate benefits?
  - Infrastructure requirement is still a TBD (security)

IntelliDrive

Opportunity for Safer Driving

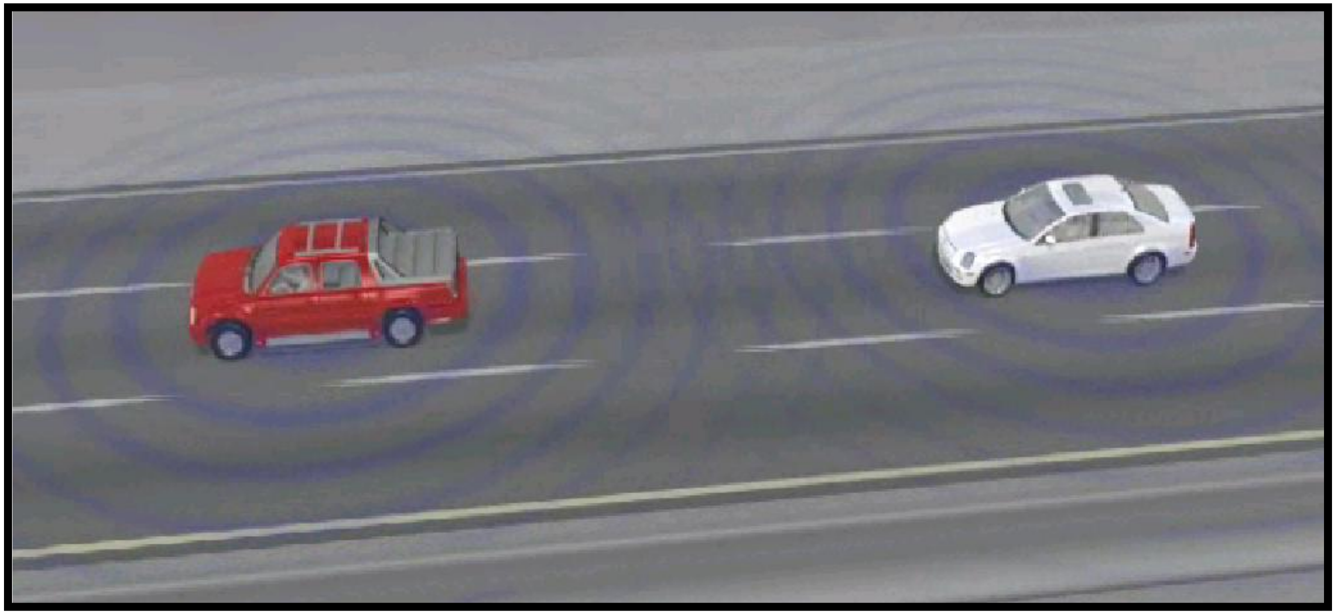
- **Greater situational awareness**
  - Your vehicle can “see” nearby vehicles and knows roadway conditions you can’t see
- **Reduce or even eliminate crashes thru:**
  - Driver Advisories
  - Driver Warnings
  - Vehicle Control

IntelliDrive has the potential to address 82% of the vehicle crash scenarios involving unimpaired drivers

Work Zone Notification

Intersection Collision Avoidance

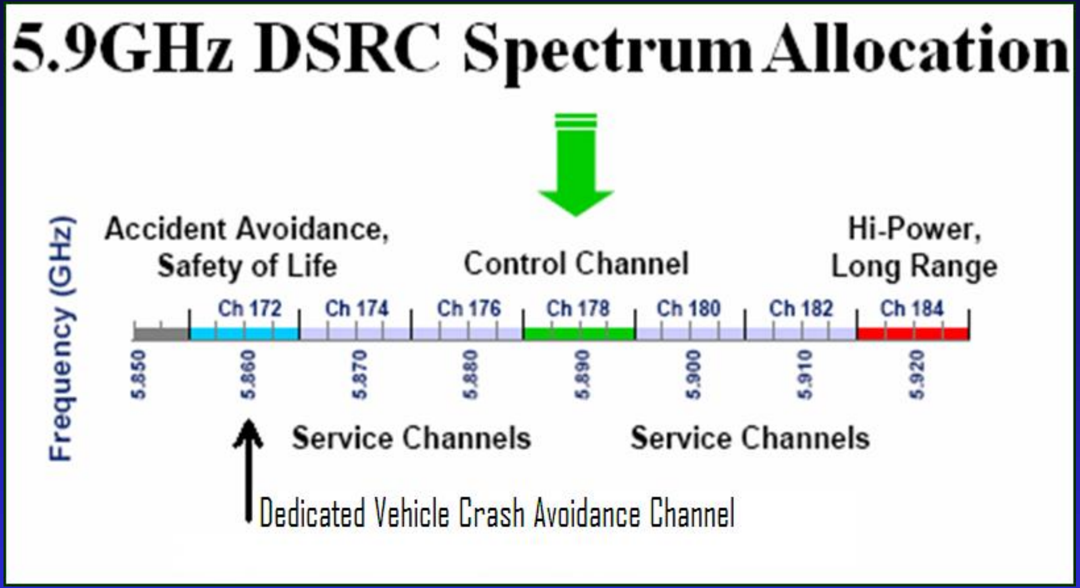
Vehicle Communications +GPS: A New Safety Sensor



- Enhances existing obstacle detection based driver assistance systems
- Offers new features not possible with existing obstacle detection based driver assistance systems
- Lower cost enables deployment to all market segments, not just luxury

History of 5.9GHz DSRC*

- **1997: ITS America petitions FCC to allocate 75 MHz of spectrum @ 5.9 GHz for ITS**
- **1999: FCC allocated spectrum**
- **February 2004: FCC Report and Order on lower layer standards, licensing and service rules**
- **July 2006: FCC Report and Order for Channel 172 – Vehicle Safety Only**



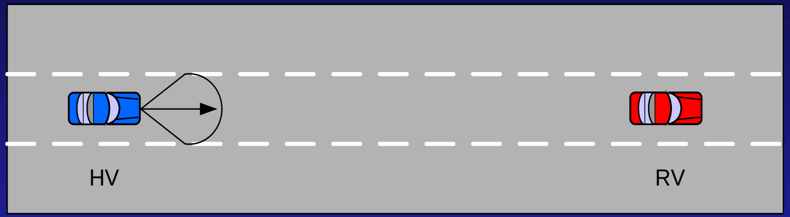
Key Benefits:

- **802.11p technology similar to 802.11a**
- **Low latency communication (<< 50ms)**
- **High data transfer rates (3 – 27 Mbps)**
- **Up to 1000m and 360°**

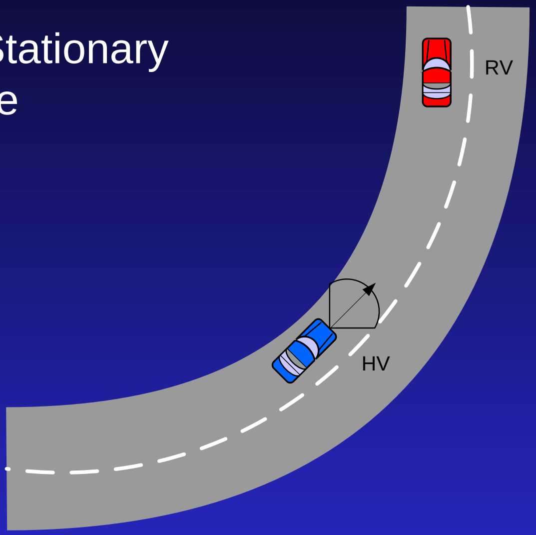
**** DSRC: Dedicated Short Range Communications***

Comparison between Radar and V2V Sensing

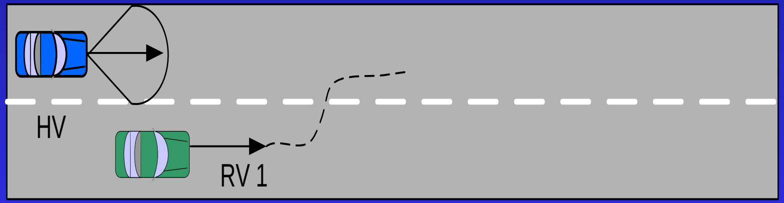
T1: Detecting a Vehicle as an In-Path Stationary Target



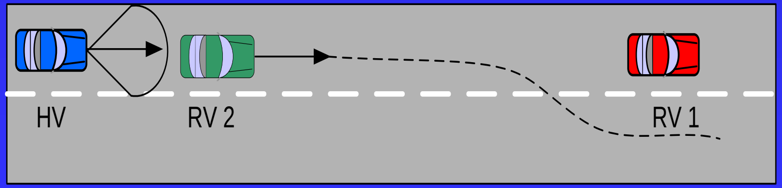
T2: Detecting a Stationary Vehicle in a Curve

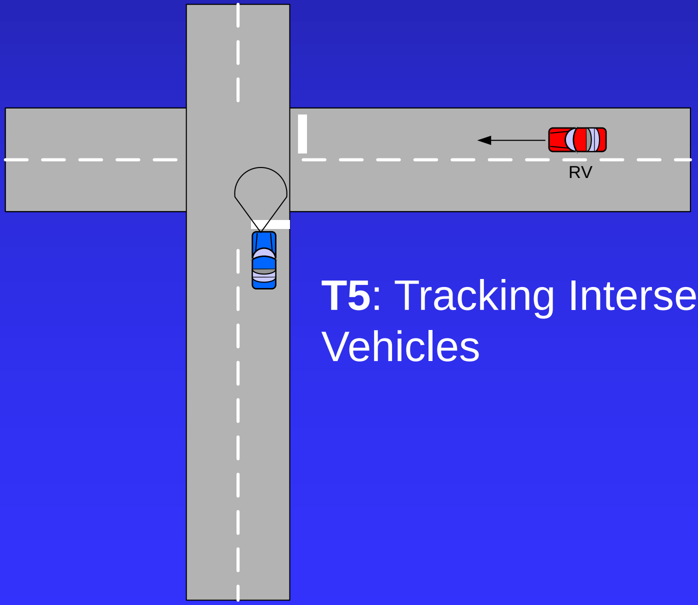


T3: Late Cut-in of Vehicle into the HV Path



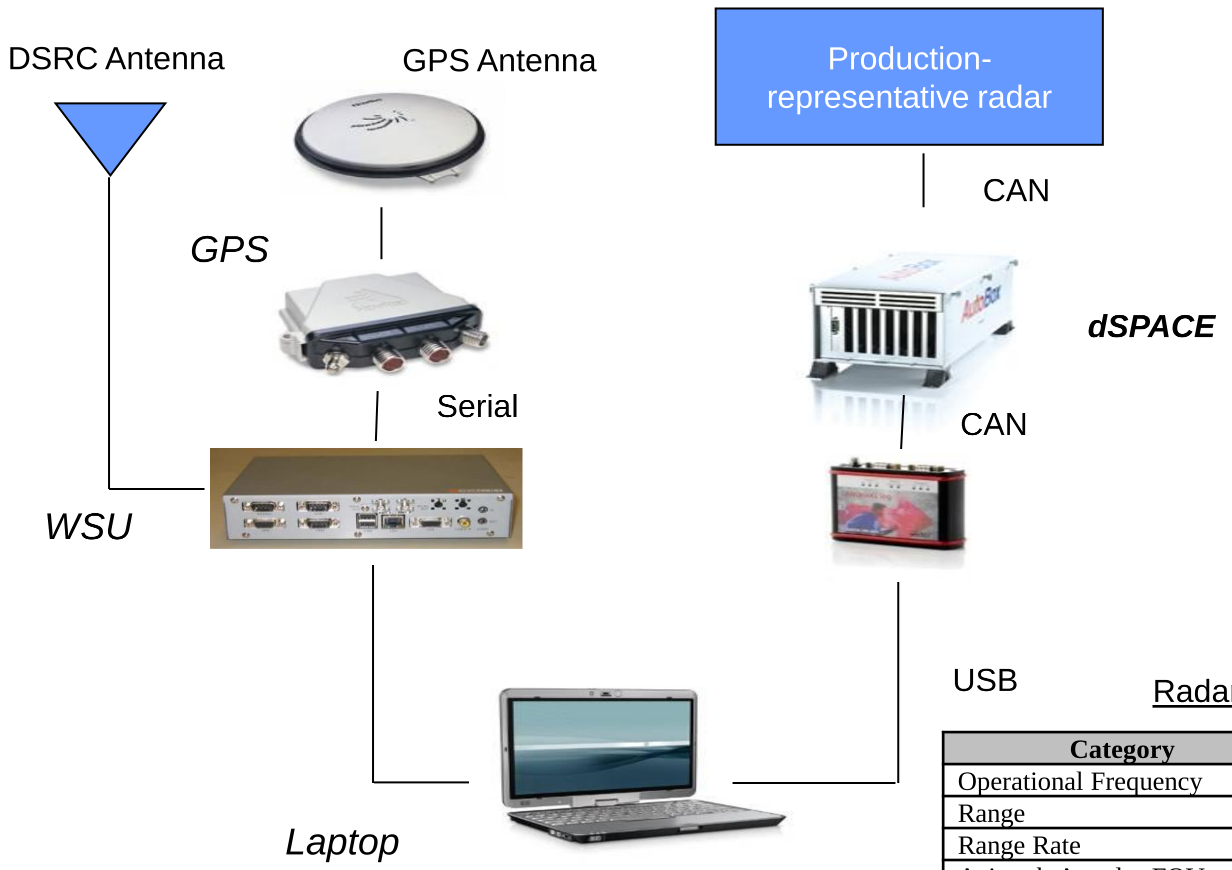
T4: Cut-out of Lead Vehicle Reveals Stopped Vehicle in Lane





T5: Tracking Intersecting Vehicles

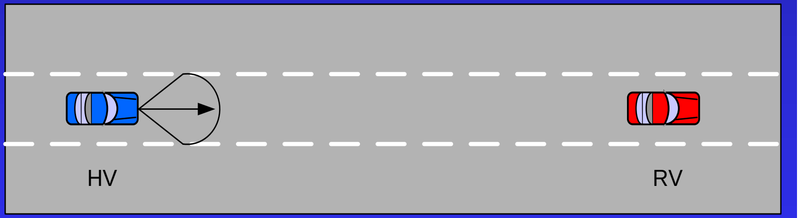
Vehicle Test Setup used



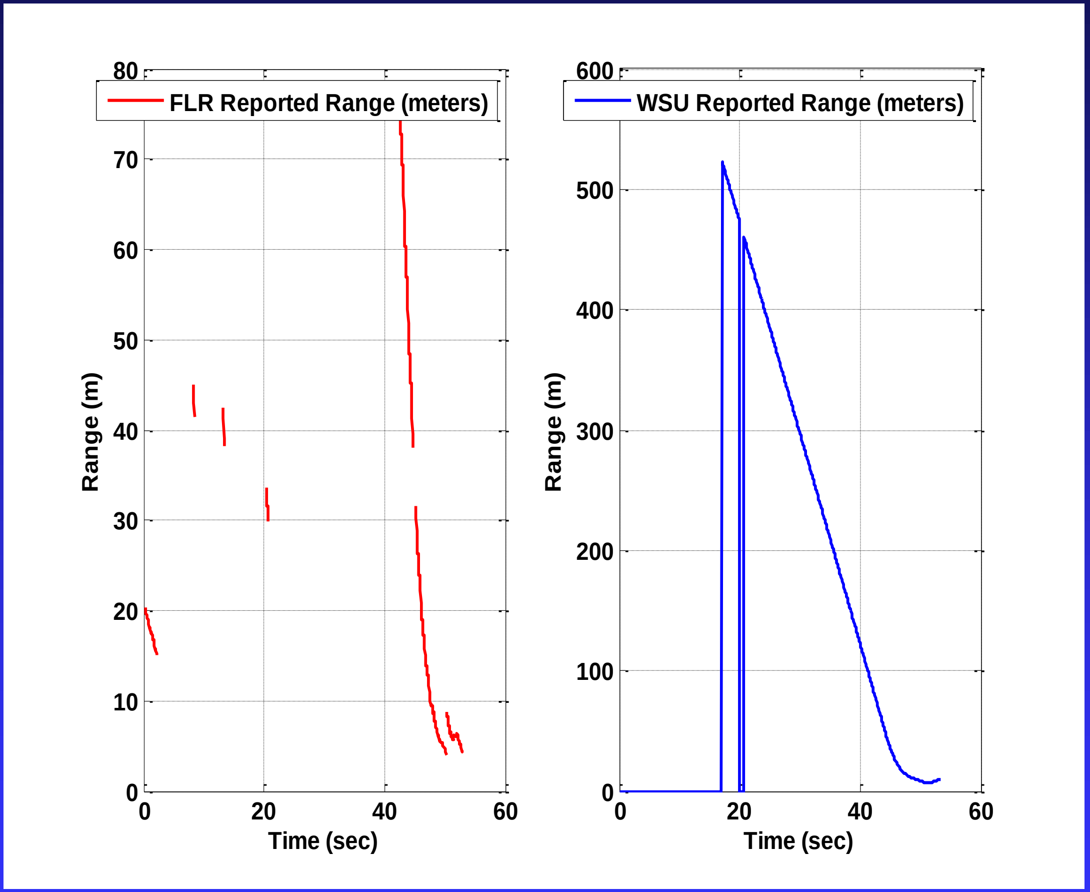
Radar Specifications

Category	Specification
Operational Frequency	76 Ghz
Range	3 to 150 m (10m^2 RCS)
Range Rate	-64 to +33 m/s
Azimuth Angular FOV	+/- 7.5 deg
Update Rate	10 Hz

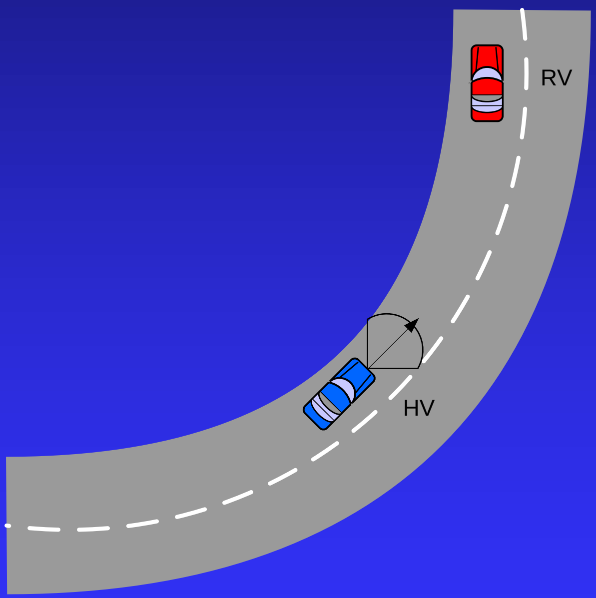
Detecting a Vehicle as an In-Path Stationary Target (in-vehicle testing)



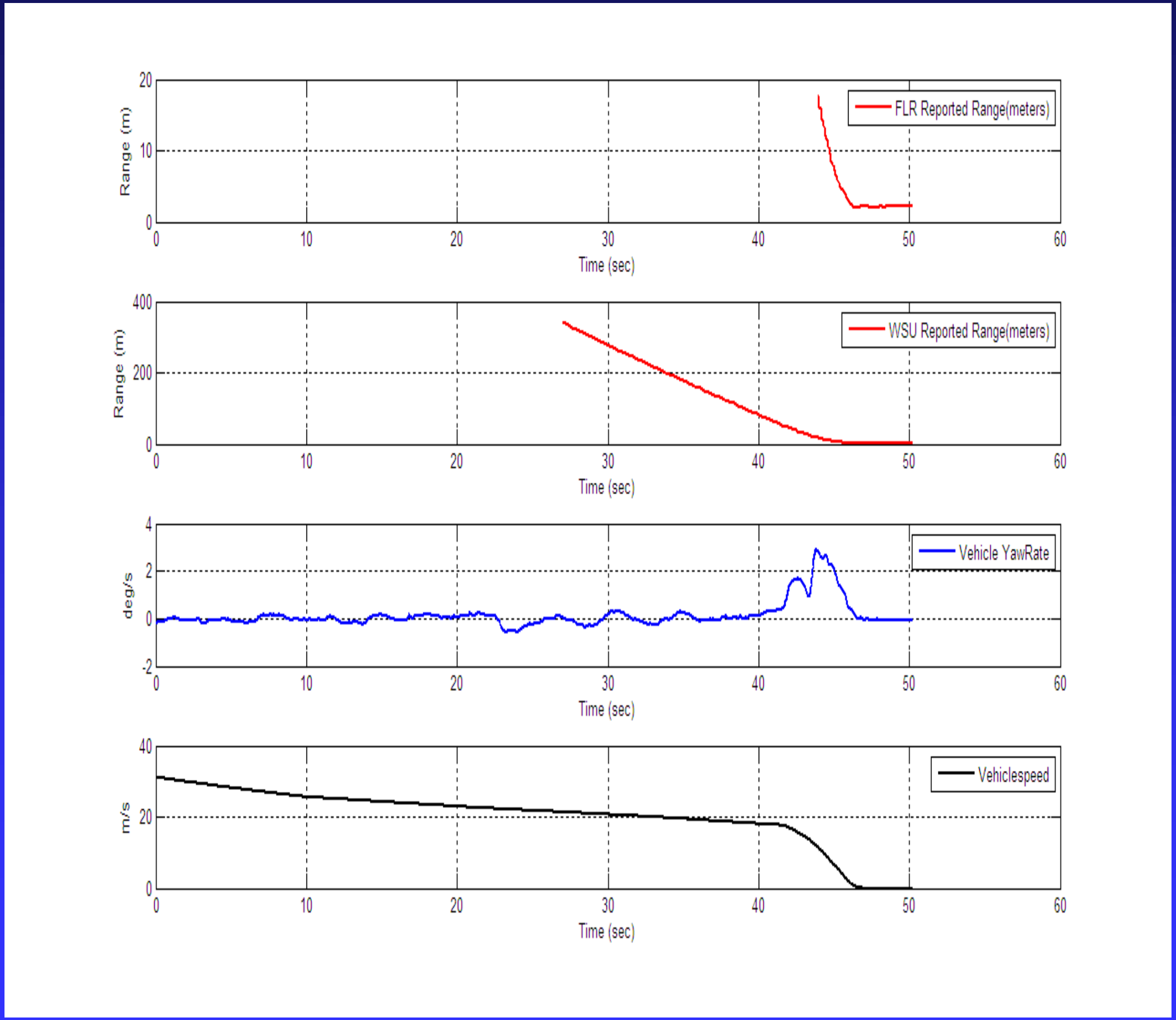
T1: Detecting a Vehicle as an In-Path Stationary Target



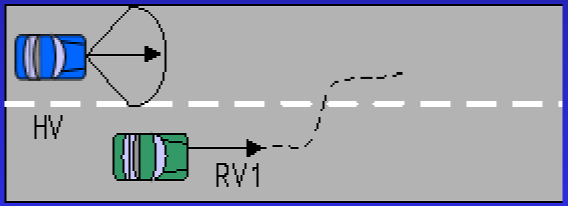
Detecting a Stationary Vehicle in a Curve (approx. 320 meter radius) (in-vehicle testing)



T2: Detecting a Stationary Vehicle in a Curve



Late Cut-in of Vehicle into the HV Path (in-vehicle testing)



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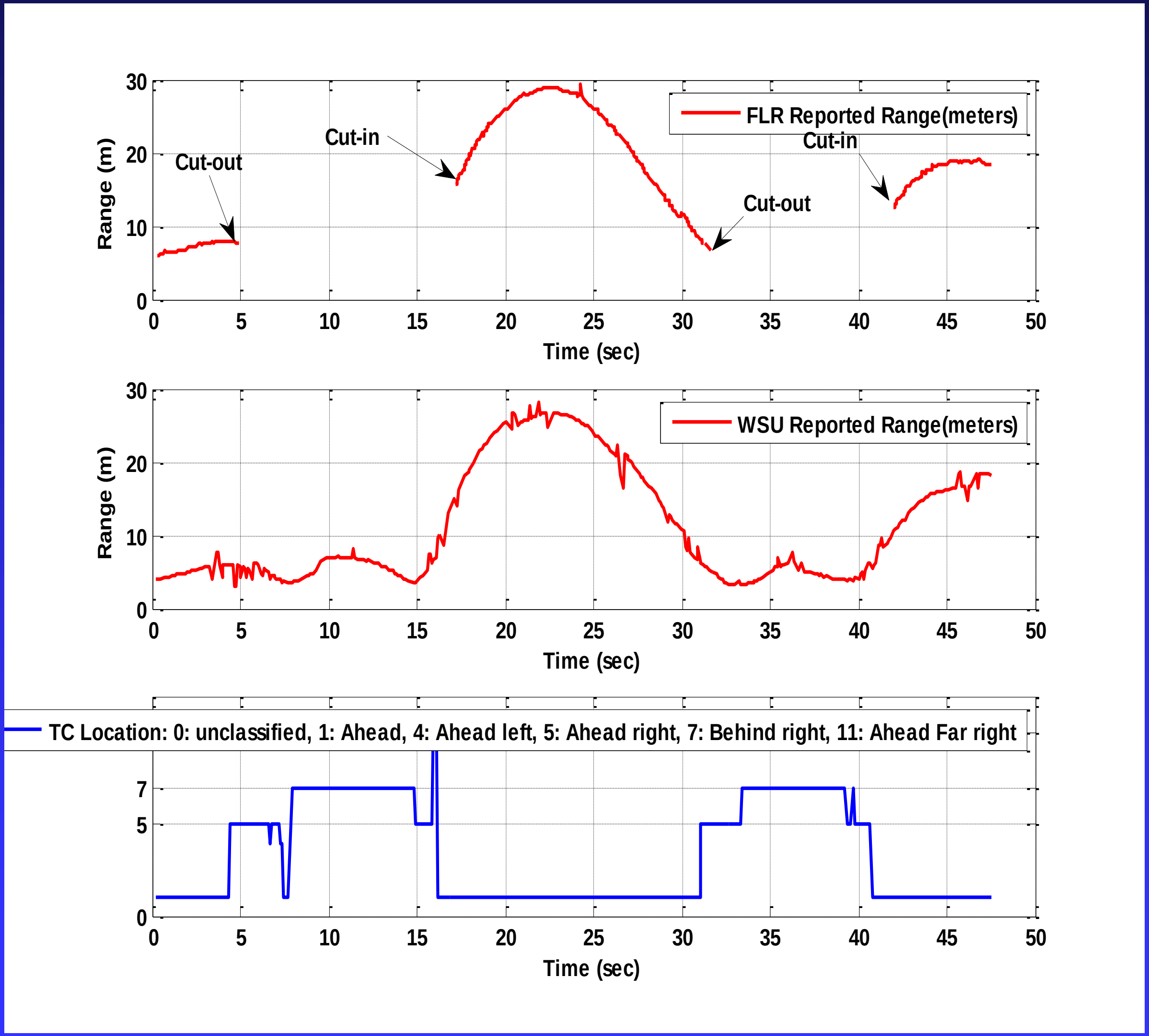
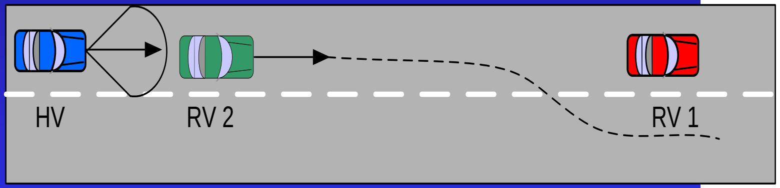
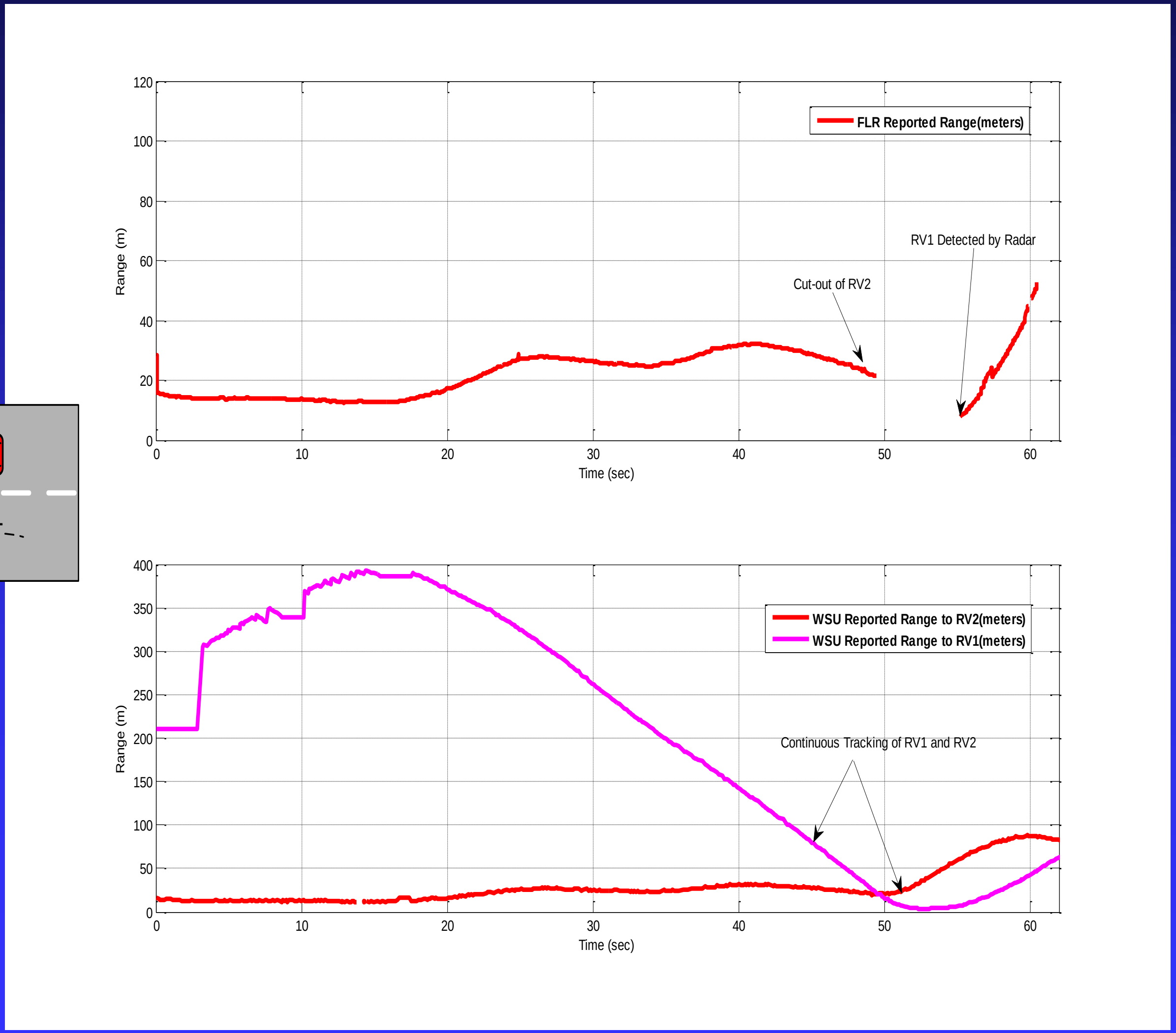


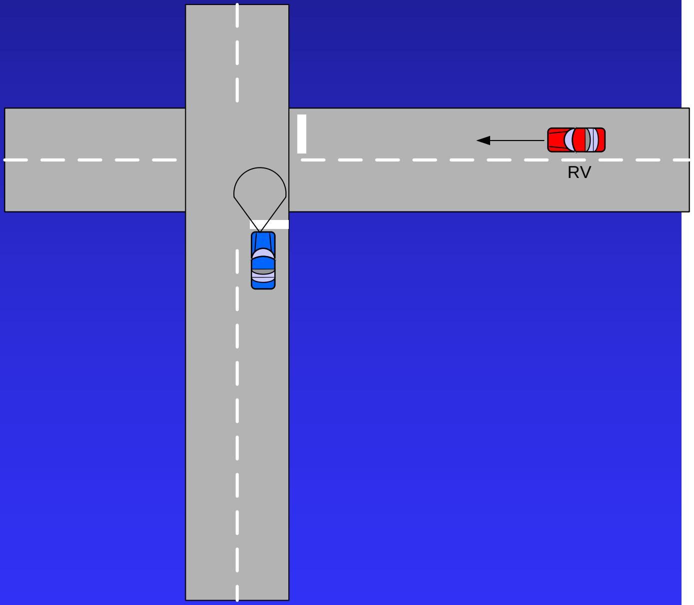
Cut-out of Lead Vehicle Reveals Stopped Vehicle in Lane (in-vehicle testing)

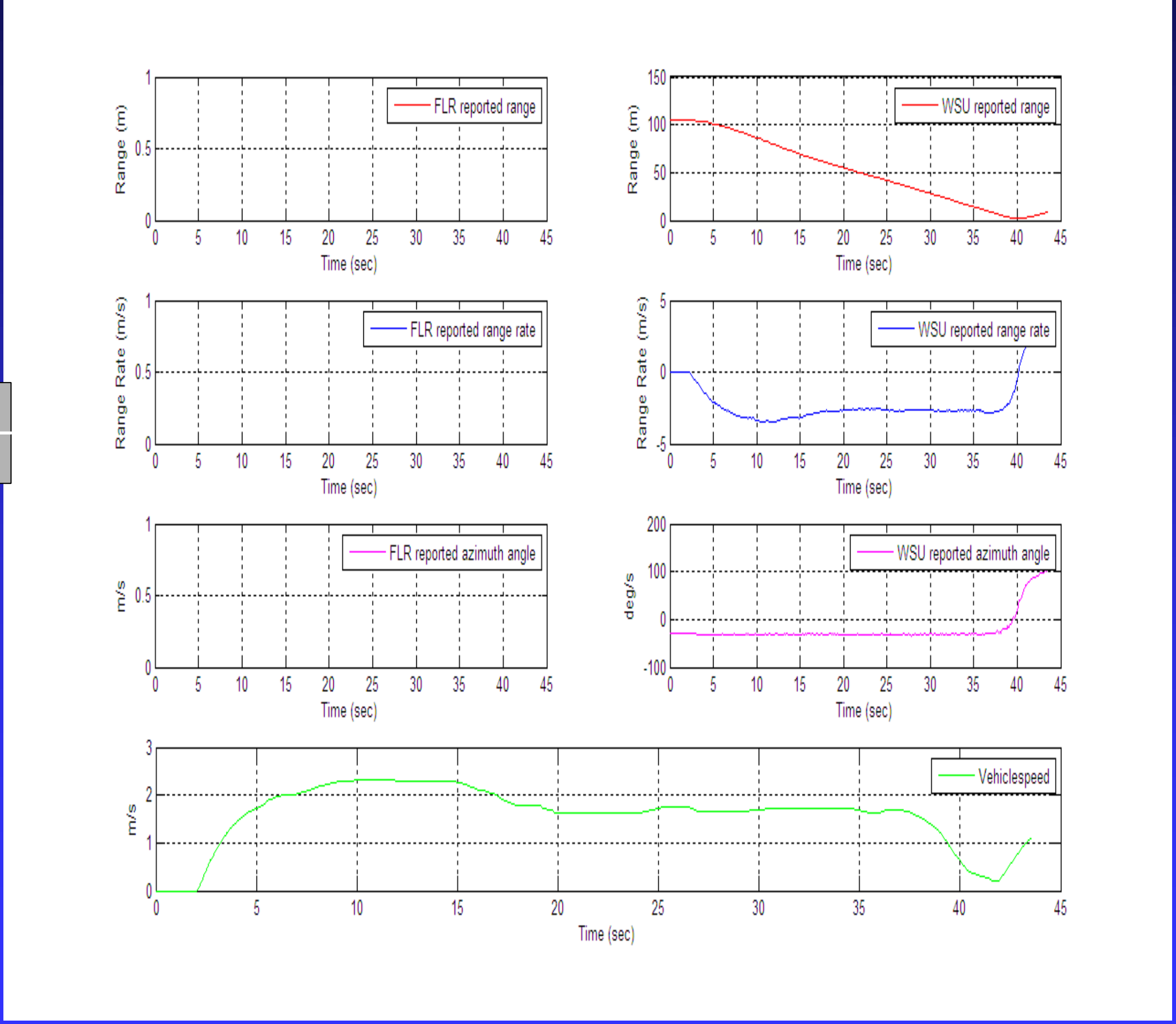




T4: Cut-out of Lead Vehicle Reveals Stopped Vehicle in Lane

Tracking an Intersecting Vehicle (in-vehicle testing)





T5: Tracking Intersecting Vehicles

VSC I
2002 - 2004

CAMP

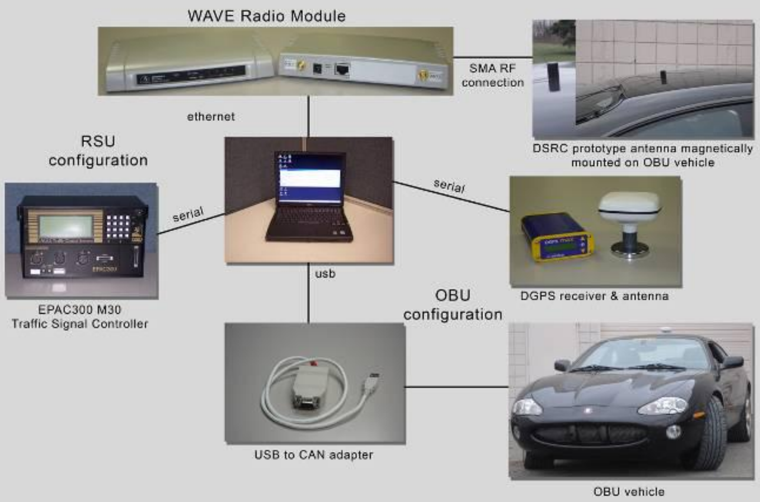
Vehicle Safety Communications Consortium

DaimlerChrysler Research, Engineering and Design North America Inc.

GM · TOYOTA · NISSAN · Volkswagen · Ford · BMW

IVI Light Vehicle Enabling Research Program

DSRC/WAVE Testing System



Potential Safety Applications

Vehicles - Vehicle

- Approaching Emergency Vehicle Warning
- Blind Spot Warning
- Cooperative Adaptive Cruise Control
- Cooperative Collision Warning
- **Cooperative Forward Collision Warning**
- Cooperative Vehicle Highway Automation System
- **Emergency Electronic Brake Lights**
- Highway Merge Assistant
- Highway/Rail Collision Warning
- **Lane Change Warning**
- Post-Crash Warning
- **Pre-Crash Sensing**
- Vehicle-Based Road Condition Warning
- Vehicle-to-Vehicle Road Feature Notification
- Visibility Enhancer
- Wrong Way Driver Warning

Vehicle - Infrastructure

- Blind Merge Warning
- **Curve Speed Warning - Rollover Warning**
- Emergency Vehicle Signal Preemption
- Highway/Rail Collision Warning
- Intersection Collision Warning
- In Vehicle Amber Alert
- In-Vehicle Signage
- Just-In-Time Repair Notification
- **Left Turn Assistant**
- Low Bridge Warning
- Low Parking Structure Warning
- Pedestrian Crossing Information at Intersection
- Road Condition Warning
- Safety Recall Notice
- SOS Services
- **Stop Sign Movement Assistance**
- Stop Sign Violation Warning
- **Traffic Signal Violation Warning**
- Work Zone Warning

Draft SAE Message Set

- **Longitude**
- **Latitude**
- **Height**
- **Time**
- **Heading Angle**
- **Speed**
- **Lateral Acceleration**
- **Longitudinal Acceleration**
- **Yaw Rate**
- **Throttle Position**
- **Brake Applied Status**
- **Brake Applied Pressure**
- **Steering Wheel Angle**
- **Headlight Status**
- **Turn Signal Status**
- **Traction Control State**
- **Anti-Lock Brake State**
- **Vehicle Length**
- **Vehicle Width**

Real World V-V Communication Performance

Publications at: http://www-nrd.nhtsa.dot.gov/pdf/nrd-12/060419-0843/

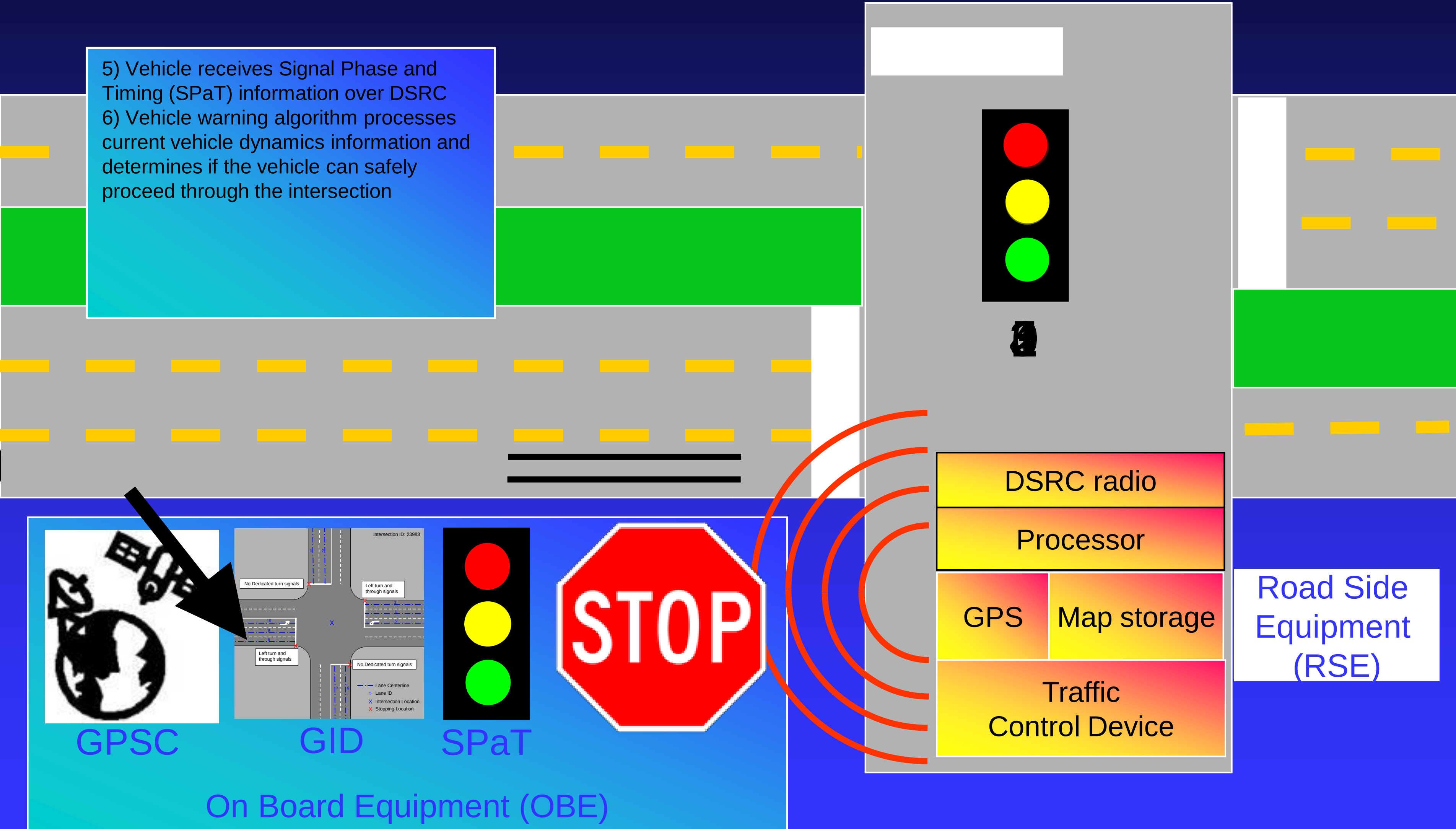
Intersection Crash Problem

- Intersection crashes account for 27.3% of all police-reported crashes, or 1.72 million crashes annually in the US.
- Straight Crossing Path crashes comprise 37% of the intersection crash problem or 636,400 crashes per year (resulting in ~$18 Billion societal harm annually)
  - 2700 fatalities per year
    - Signal Violation: 1200 Fatalities
    - Stop sign Violation: 1500 Fatalities
- Autonomous countermeasures have limited effectiveness for intersection crashes.

Numbers by NHTSA and FHWA

Smart Intersection Concept of Operations

5) Vehicle receives Signal Phase and Timing (SPaT) information over DSRC
6) Vehicle warning algorithm processes current vehicle dynamics information and determines if the vehicle can safely proceed through the intersection



Smart Intersection Project Results

- A reference implementation of a system that can be used for a large-scale Field Operational Test with naïve drivers was developed
- The system was successfully tested with 87 naïve drivers in a pilot Field Operational Test in Blacksburg, Virginia
- The system was effective in warning a driver when a potential violation was detected while minimizing false alerts

Field Operational Test of Smart Intersections

- Live intersection data suggests that the FOT will yield approximately 900 total violations to examine the potential benefits of a system
- The FOT data will enable study of:
  - The potential safety benefits:
    - How many true alerts and nuisance alerts will naïve drivers experience?
    - When drivers do violate, how often is there an imminent threat?
    - What are naïve driver's reactions to alerts under different conditions, and how does this impact the potential benefits?
  - Customer acceptance:
    - Do drivers believe in, and rely upon the systems?
    - Does this change over time?
  - Any unintended consequences?
    - Increased rear-end collision frequency
    - Over reliance on the system
    - Misuse of the system

Current FOT Assumptions	
Number of Vehicles	50
Weeks of Data Collection	52
Number of Drivers	200
Weeks per Driver	12
Trips per week per driver	10
Signals per Trip	24
Stop Signs per Trip	4

FOT Predicted Benefit			
	Signalized	**Stop Sign**	**Combined**
Total Crossings	**576,000**	**96,000**	**672,000**
Total Violations	**304**	**586**	**890**

V2V Safety Communications Applications

- 3 year project - December 2006 to December 2009
- Collaborative effort between 5 OEMs (Ford, GM, Honda, Mercedes & Toyota) and US DOT
- Goal: Determine if DSRC @5.9 GHz & vehicle positioning can improve upon autonomous vehicle-based safety systems and/or enable new communication-based safety applications

CAMP

Vehicle Safety Communications 2

Mercedes-Benz
Research & Development North America, Inc.

GM

TOYOTA

HONDA
Honda R&D Americas, Inc.

Ford

Intelligent Transportation Systems

DEPARTMENT OF TRANSPORTATION
UNITED STATES OF AMERICA

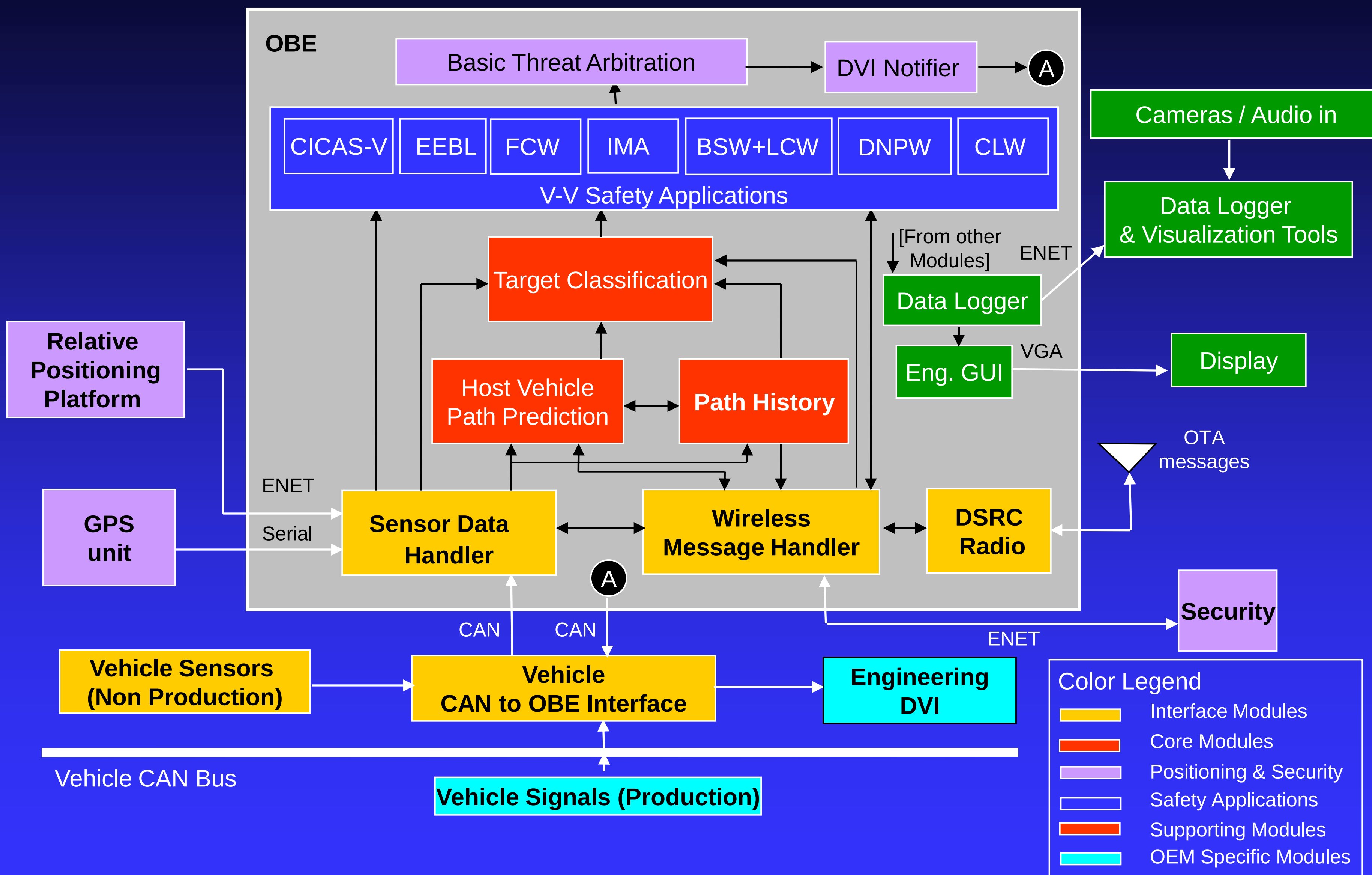
Safety Applications *vs.* Crash Scenarios Mapping

	V2V Safety Applications → / Crash Scenarios ↓	EEBL	FCW	BSW	LCW	DNPW	IMA	CLW
1	Lead Vehicle Stopped		✓					
2	Control Loss without Prior Vehicle Action							✓
3	Vehicle(s) Turning at Non-Signalized Junctions						✓	
4	Straight Crossing Paths at Non-Signalized Junctions						✓	
5	Lead Vehicle Decelerating	✓	✓					
6	Vehicle(s) Not Making a Maneuver – Opposite Direction					✓		
7	Vehicle(s) Changing Lanes – Same Direction			✓	✓			
8	LTAP/OD at Non-Signalized Junctions						✓	

Note: Crash Scenario reference: "VSC-A Applications_NHTSA-CAMP Comparison v2" document, USDOT, May 2 2007. Selected based on 2004 General Estimates System (GES) data and Top Composite Ranking (High Freq., High Cost and High Functional Years lost).

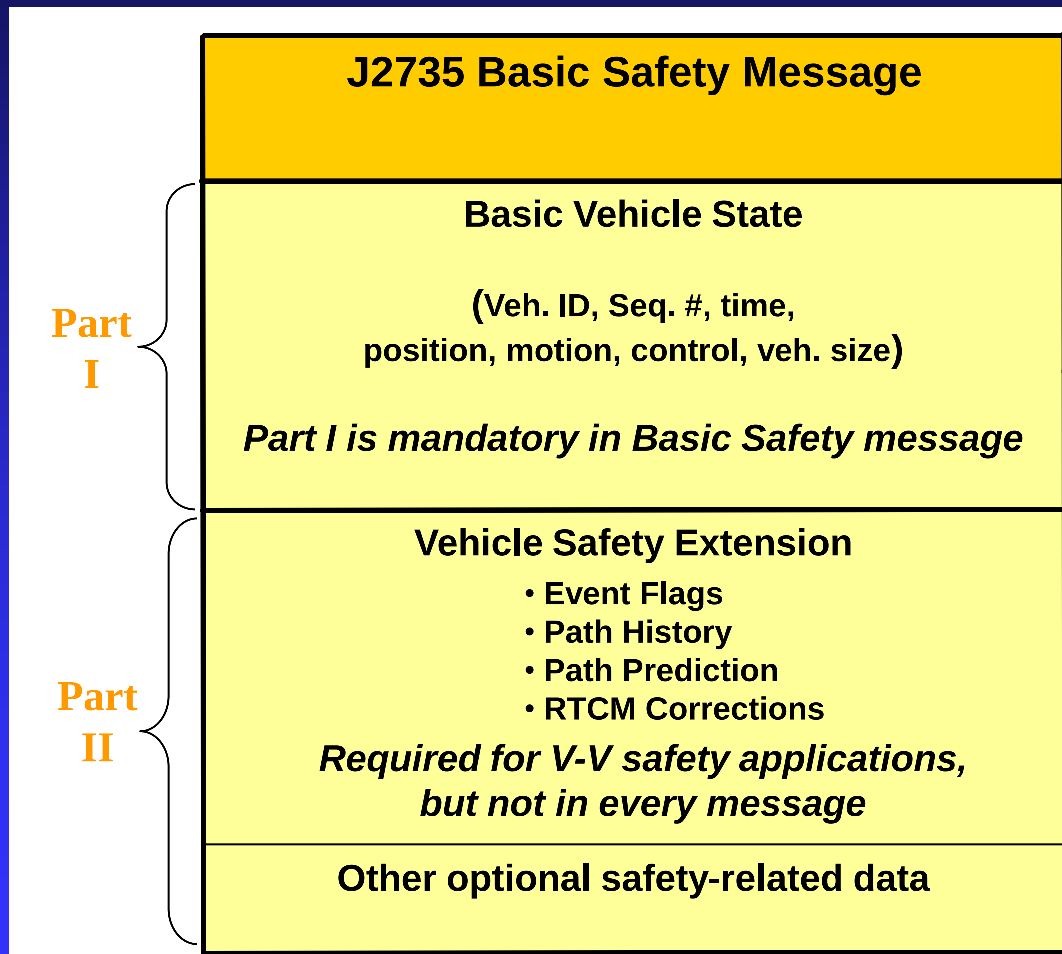
EEBL: Emergency Electronic Brake Lights
FCW: Forward Collision Warning
BSW: Blind Spot Warning
LCW: Lane Change Warning
DNPW: Do Not Pass Warning
IMA: Intersection Movement Assist
CLW: Control Loss Warning

VSC-A System Test Bed

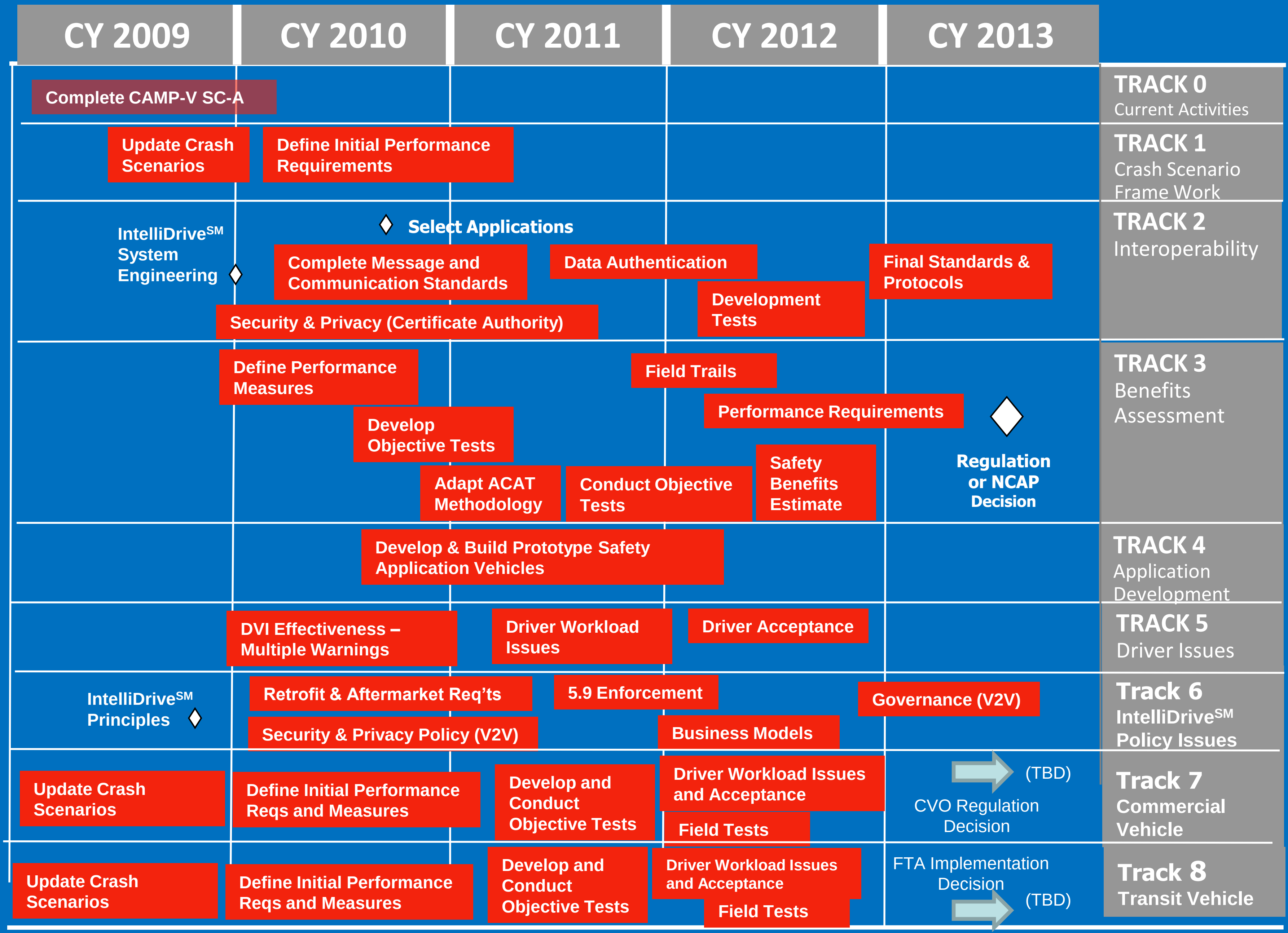


Interoperable Communication: SAE J2735 Message Set

- Periodic safety message broadcast (10 times per second)
- Event-driven safety message broadcast (immediate on event occurrence)



Vehicle to Vehicle Safety Application Research Plan



Interoperability Issues of Vehicle-to-Vehicle Based Safety Systems Project (V2V-Interoperability)

CAMP

Vehicle Safety Communications 3

Mercedes-Benz
Research & Development North America, Inc.

GM

TOYOTA

HONDA
Honda R&D Americas

Ford

NISSAN

KIA
HYUNDAI·KIA MOTORS
Hyundai · Kia America Technical Center, Inc.

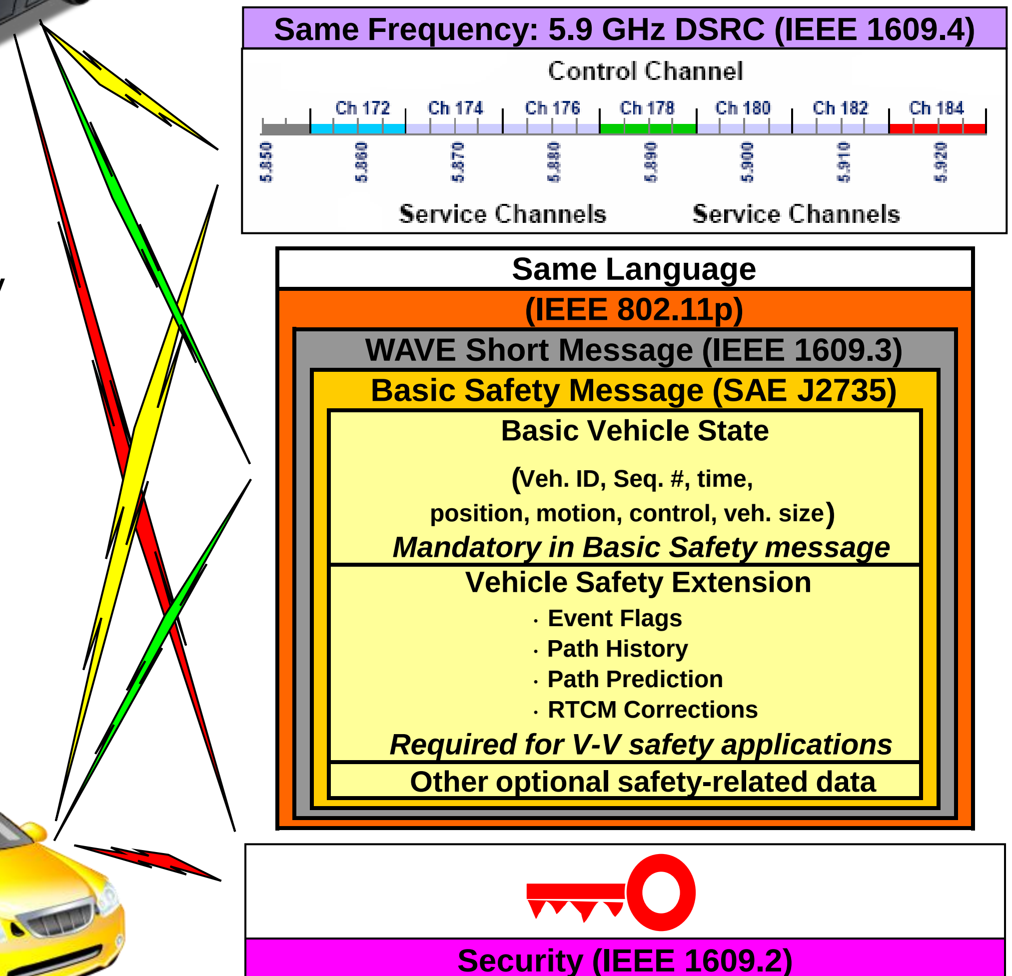
VOLKSWAGEN
GROUP OF AMERICA

Intelligent Transportation Systems

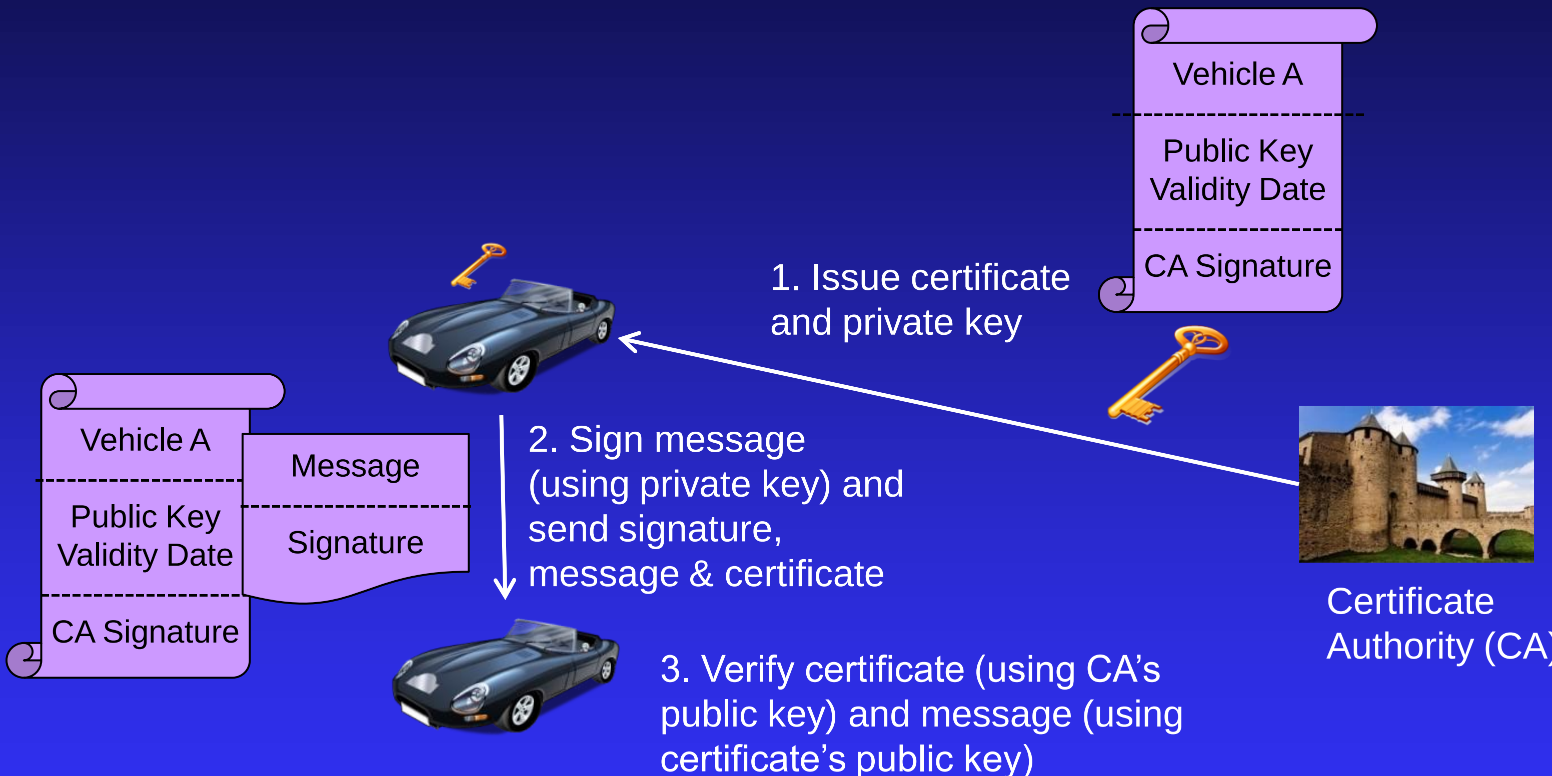
General Requirements

Required for Deployment:

- Different Manufacturers
- Communicating on the Same Frequency
  → *Where do we go to talk*
- Using the Same Language
  → *We understand each other*
- With Security
  → *We trust what we are saying to each other*



V2X Security Using PKI



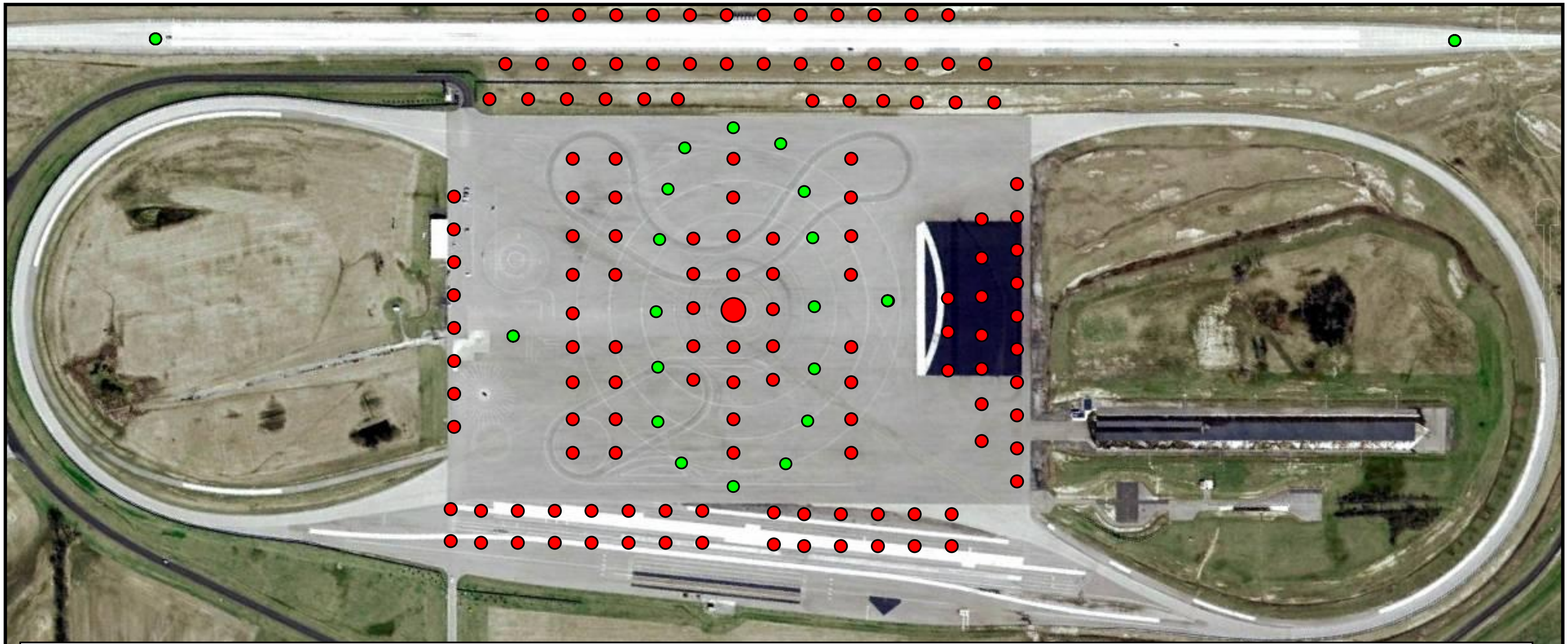
378 byte total OTA packet size

156 byte for V2V message (without positioning)

222 bytes for security overhead

Scalability Testing

- Test with Both static (red) and moving (green) vehicles
- Multiple Scaling increments (50, 100, 200+ vehicles)
- Employ control and mitigation techniques
- Integrate Security Solution
- Potentially incorporate RSE transmitting at higher power than vehicles

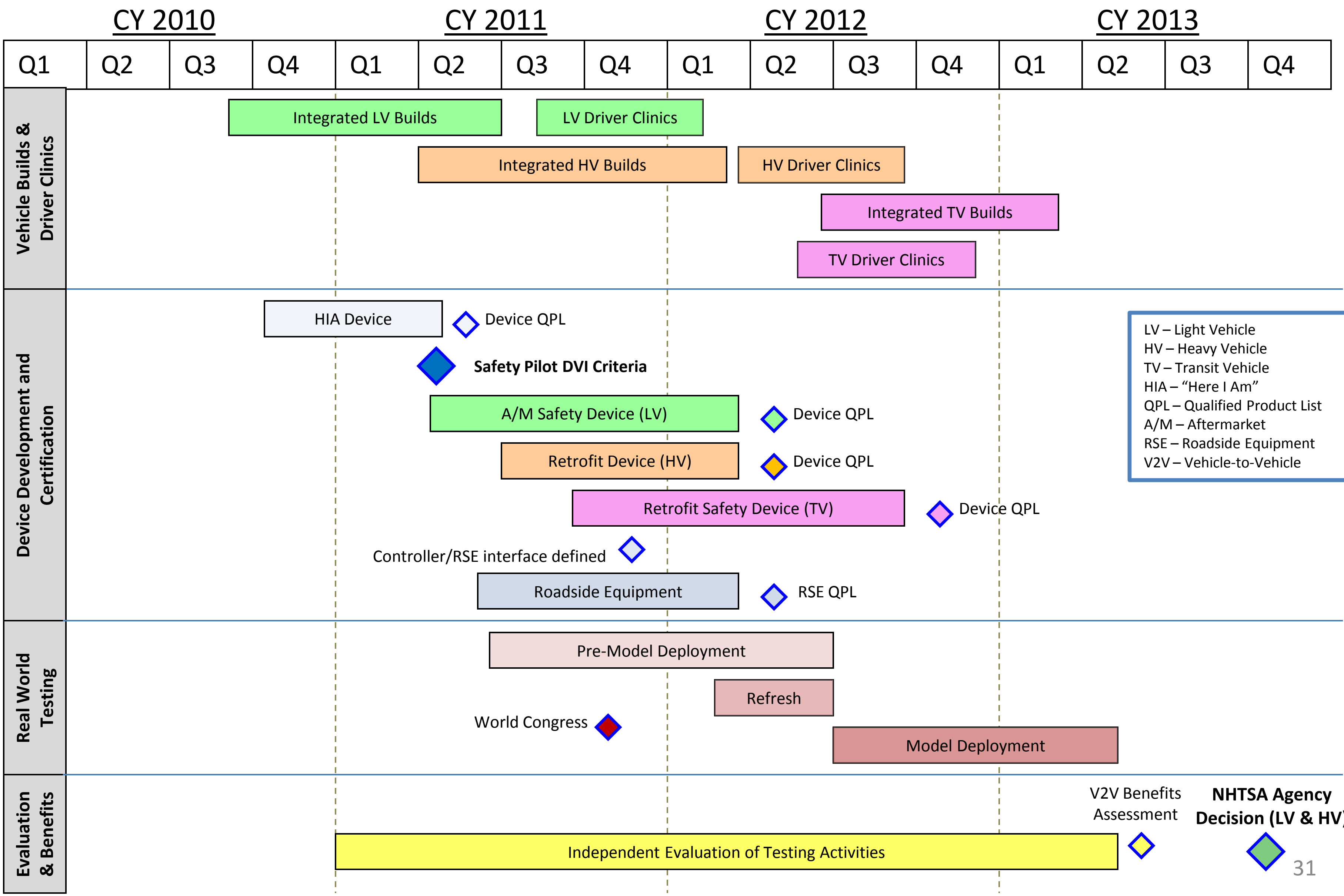


NOTE: The animation in this diagram is for illustration purposes only. The actual deployment of static and moving vehicles will be determined through the activities of this task.

Key Policy Issues

- **Harmonization – need for global harmonization**
- **Institutional Issues - including privacy, liability, patent or IP issues, data ownership, and spectrum use**
- **Legislative Analysis - to identify cross-jurisdictional issues and other potential legal impacts**
- **Implementation and Operations - including deployment scenarios, interoperability, certification, security and need for an infrastructure**
- **Investment and Funding Analysis - to develop a set of public and private sector investment models**
- **Benefits/Cost Analysis - to support deployment decision**

IntelliDrive Safety Pilot Roadmap (rev 20c)



Market Penetration Analysis for VSC-A

James Chang
11/5/09

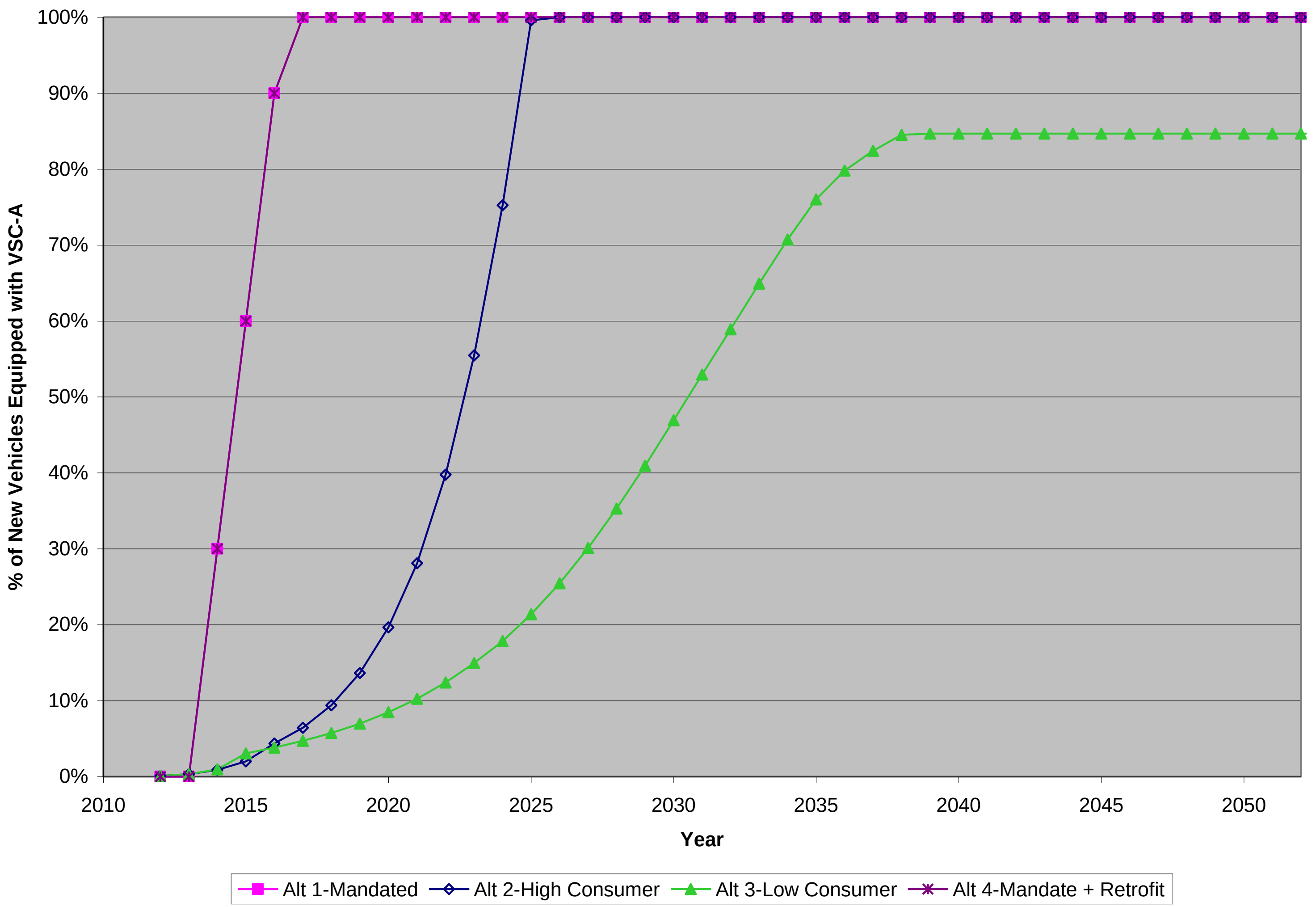
Prepared for ITS JPO/NHTSA
Contract #: DTFH61-05-D-00002

noblis
For the best of reasons

Overview

- Market Penetration for Communications-Based Safety (V2V)
  - Need deployment for crash avoidance
  - Guidance based on range of alternative scenarios
  - Provide input to Safety Benefits Opportunities Estimation process
- Model Market Penetration Over Analysis Period
  - 2012-2052
- Four Alternatives Considered
  - Mandate or No Mandate
  - Consumer-based
    - Bass Model with Innovation and Imitation Factors
    - High and Low levels modeled after ESC/ABS
  - Retrofit or No Retrofit
  - More TBD

New Vehicles Equipped



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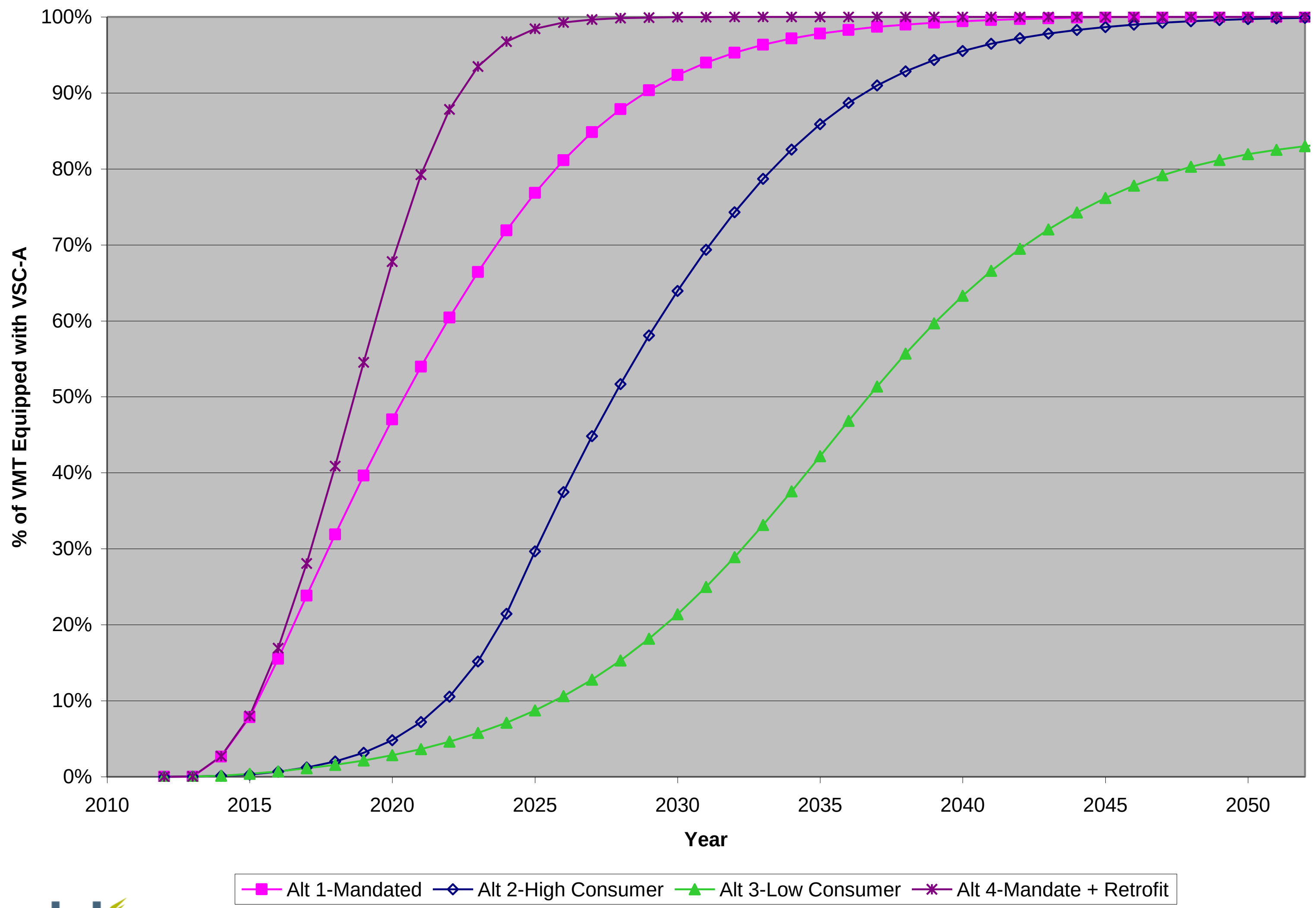
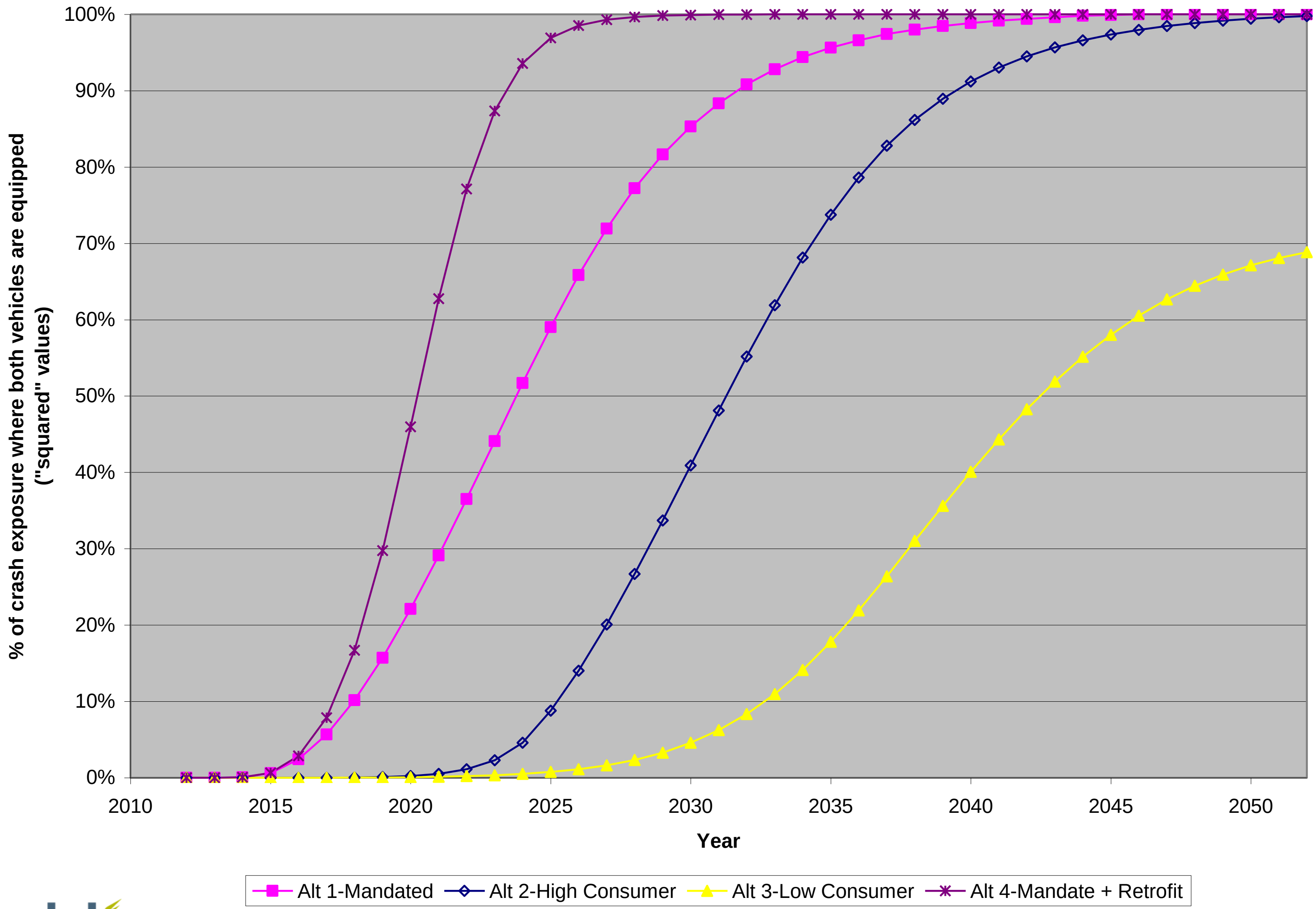
% of Vehicle Miles Equipped



% of crash exposure with both vehicles equipped



Discussion

2014 ITS WORLD CONGRESS

Destination Detroit

October 20-24, 2014

Detroit ITS World Congress

October 20-24, 2014

- World's largest meeting on transportation technology
  - Rotates annually between Europe, Asia & the Americas
  - More than 10,000 delegates from all over the world
- Hundreds of technical sessions
- Exhibition
- Technology showcase

Current Status

- All eyes on Orlando
- Preliminary Planning for Detroit
  - Promotion Plan developed
  - 2014 Organizing Committee being formed
  - Partnerships being established
  - Connected Vehicle technology deployment plans underway

Vision

- Attract more than 10,000 delegates
- With regulatory decision in 2013, demonstrate first “production” equipped vehicles
- Establish Michigan as the undisputed world leader in Connected Vehicle Technologies – Reinvention of the auto industry
- Establish sustainable deployment of connected vehicle technology
- Take Technology Showcase to the “next level”

Implications for Industry

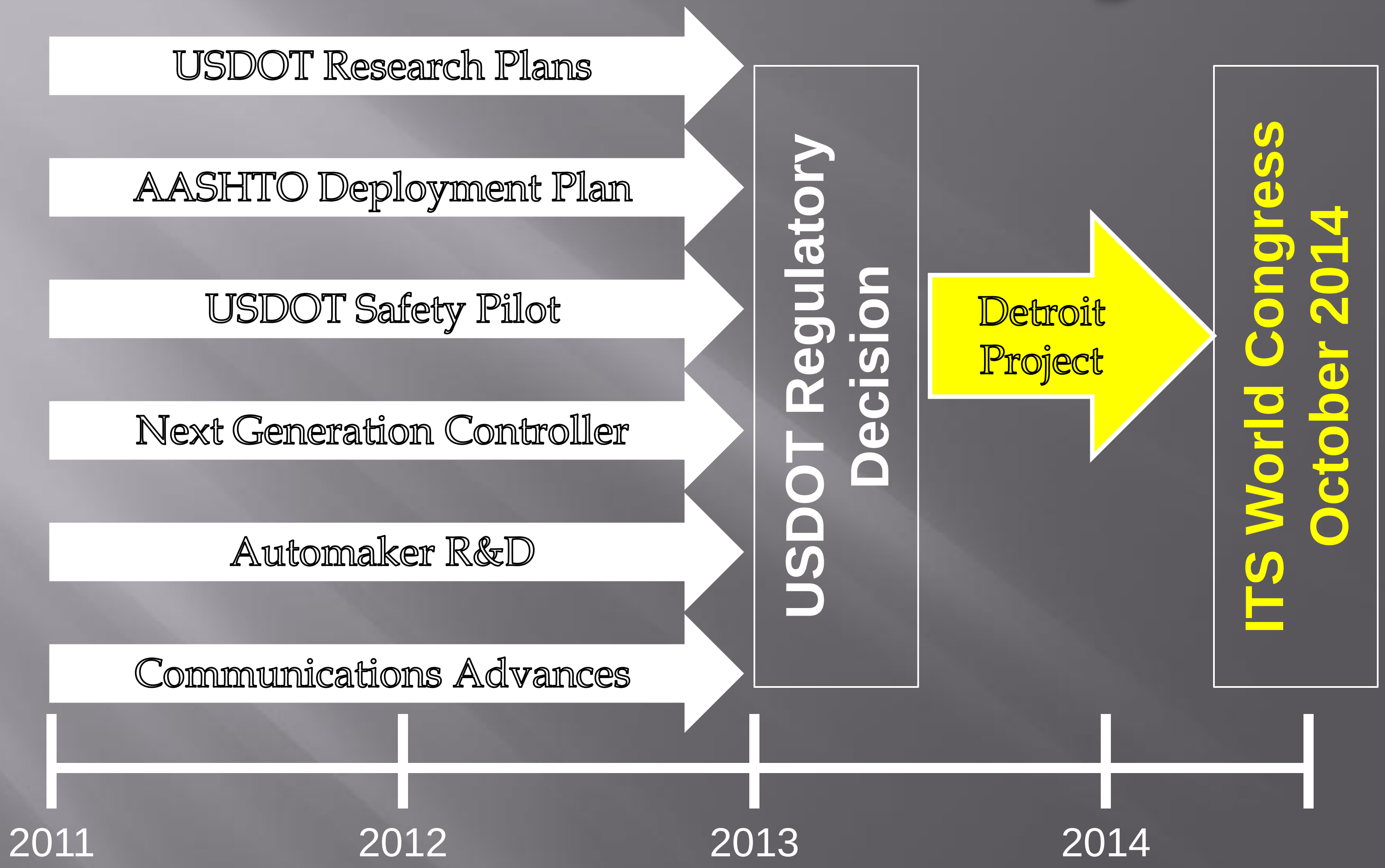
- Re-invention of Michigan and Detroit
  - Could Detroit become the “Silicon Valley” of connected vehicle technology?
  - “Last Frontier” for the internet
  - Includes different industry segments
- Potential to re-invent Michigan’s core industry segment
  - Leverage our connected vehicle capabilities, the power of our automotive sector, new industry partnerships and the engineering talent residing in Michigan
  - Collaboration is key

Collaboration

Connected Vehicle Industry

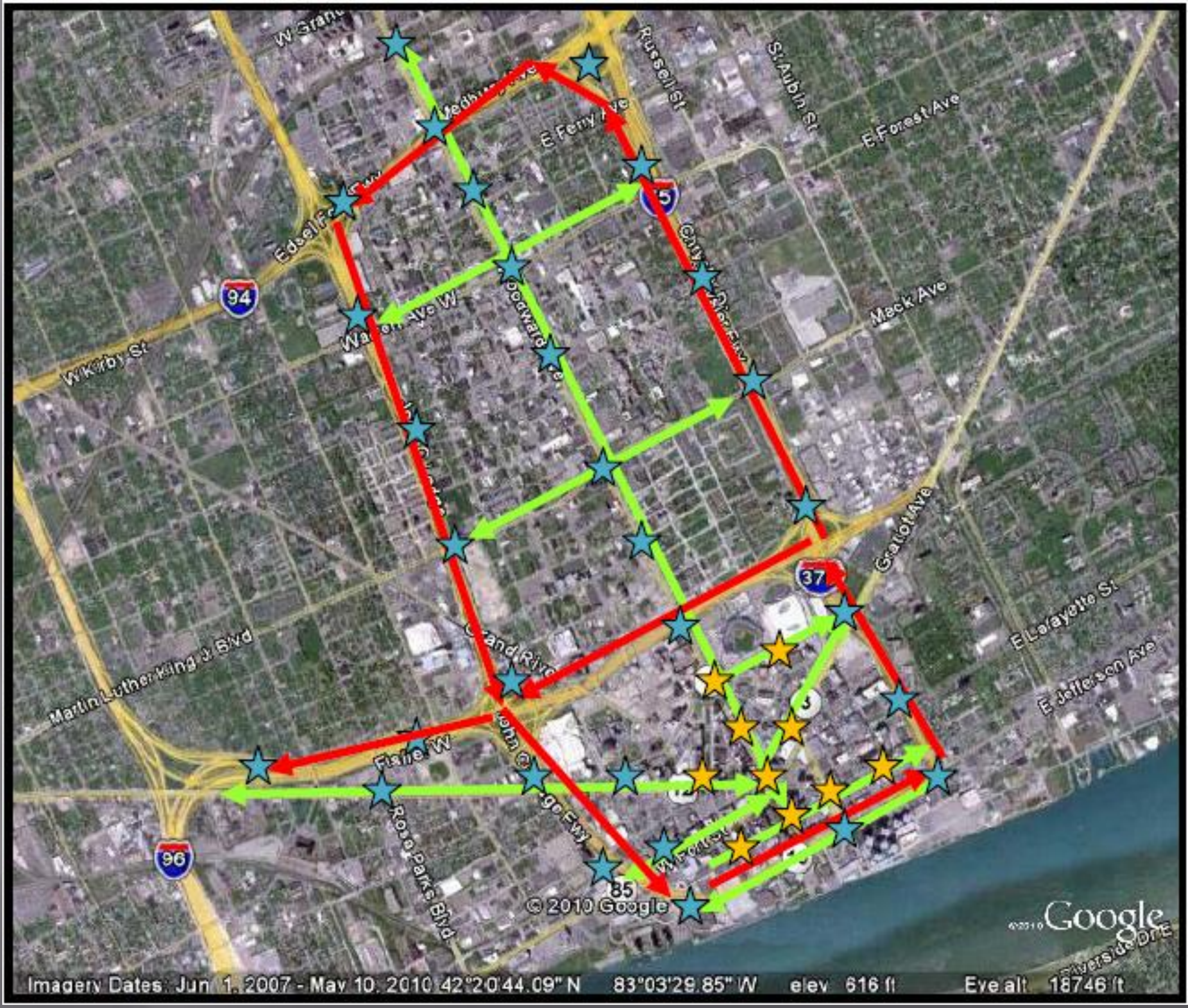
- Federal, State & Local Government
- Academic Institutions
- Automakers & Suppliers
- TACOM & TARDEC
- Robotics
- Alternative Energy
- Communications

2014 ITS World Congress



Connected Vehicle Deployment

- Sustainable Urban Deployment
- Multimodal
- Cross-Jurisdictional
  - MDOT
  - City of Detroit
- Numerous Applications
  - Arterial & Freeway
  - Transit
  - Integration with M-1 Rail
  - Toll / Tunnels
  - Pedestrian Safety
  - Corridor Mgmt
  - Special Events



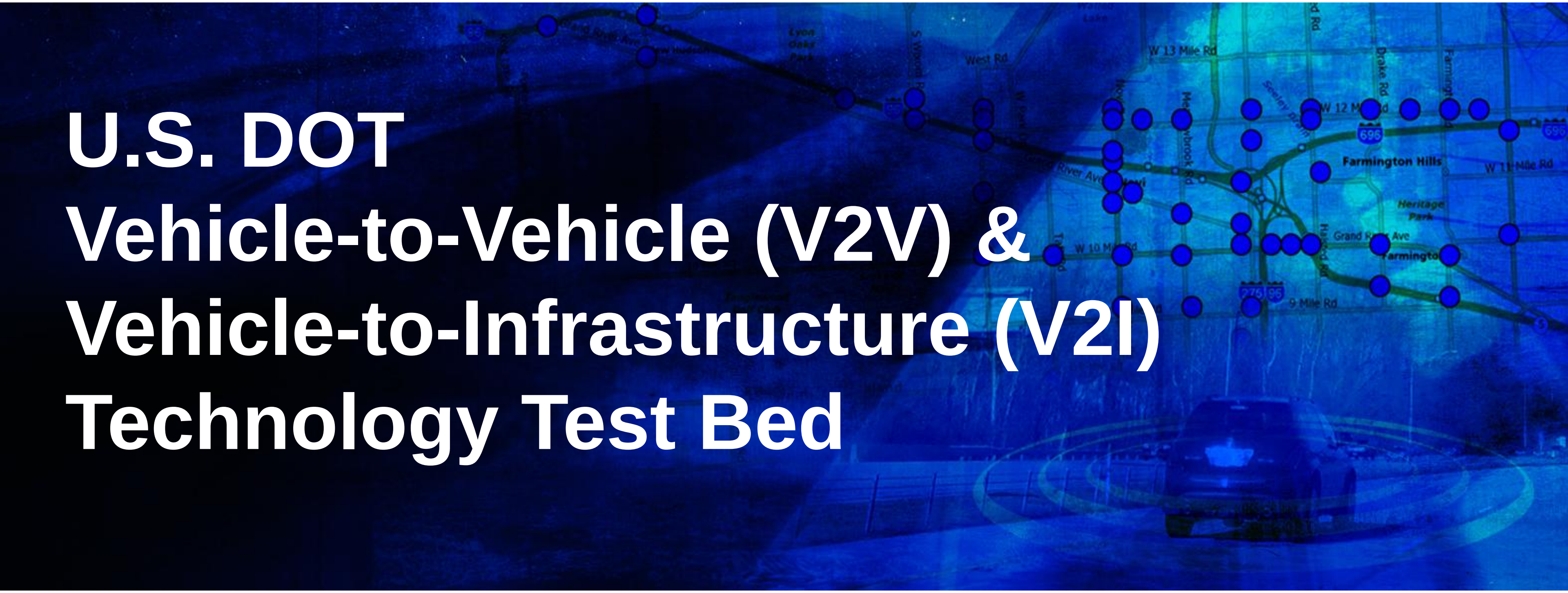
What Is Possible in 2014?

- What is the "next level"?
  - Technology Advances?
  - Applications?
- Leveraging our regional resources
  - Facilities
  - Brainpower
- World Congress format changes
  - More consumer-oriented exhibition?
  - CES / Auto Show flavor?
- More media coverage – market to the media

Detroit ITS World Congress

October 20-24, 2014

DISCUSSION



U.S. DOT
Vehicle-to-Vehicle (V2V) &
Vehicle-to-Infrastructure (V2I)
Technology Test Bed

Operated and Maintained by

SAIC
From Science to Solutions

Briefing to

Connected Vehicle Working Group

May 2, 2011

Taso Zografos

Imagine a world where…

- Vehicles communicate with other vehicles, so that drivers are alerted when a crash is imminent

- Vehicles can warn a driver about nearby school zones, sharp curves or slippery patches of roadway

- Vehicles communicate with roadside infrastructure, so a traffic signal controller informs your vehicle when the signal will change to red so you can better manage your speed to arrive on the green

Approaching 2013 Milestone

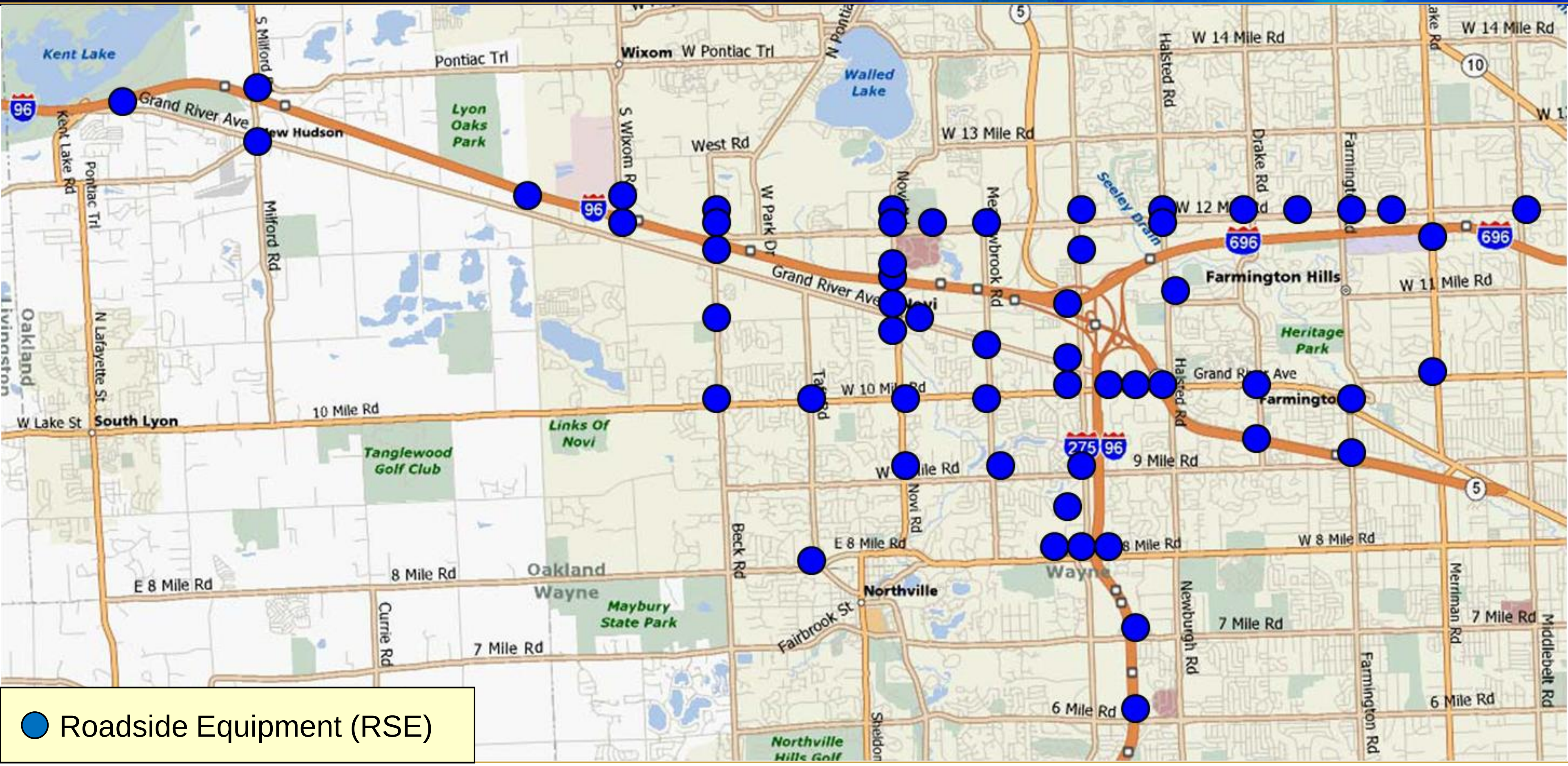
“Decision to Make a Decision on Possible Next Steps”

National Highway Transportation Safety Administration (NHTSA) determined in 2010 that V2V communications had the potential to significantly reduce traffic accidents and declared an intent to begin the process to initiate a regulatory decision in **2013** on whether to require inclusion of V2V technologies in new vehicles

Focus on Applications to Improve Safety, Mobility, & Environment

	Applications						
	Safety			Mobility		Environment	
	V2V	V2I	Safety Pilot	Real Time Data Capture/ Management	Dynamic Mobility Applications	AERIS	Road Weather Applications
Technology	Harmonization of International Standards and Architecture						
	Human Factors						
	Systems Engineering						
	Certification						
	Testing						
Policy	Deployment Scenarios						
	Financing and Investment Models						
	Operations and Governance						
	Institutional Issues						

V2V & V2I Technology Test Bed Location



Oakland County, MI centered in cities of Novi, Farmington, Farmington Hills, and Livonia with expansion into Southfield

Test Bed Core Components

- **55 Roadside Equipment (RSE) sites**
  - 12 freeway
  - 42 signalized intersections
  - Over 45 square miles covered

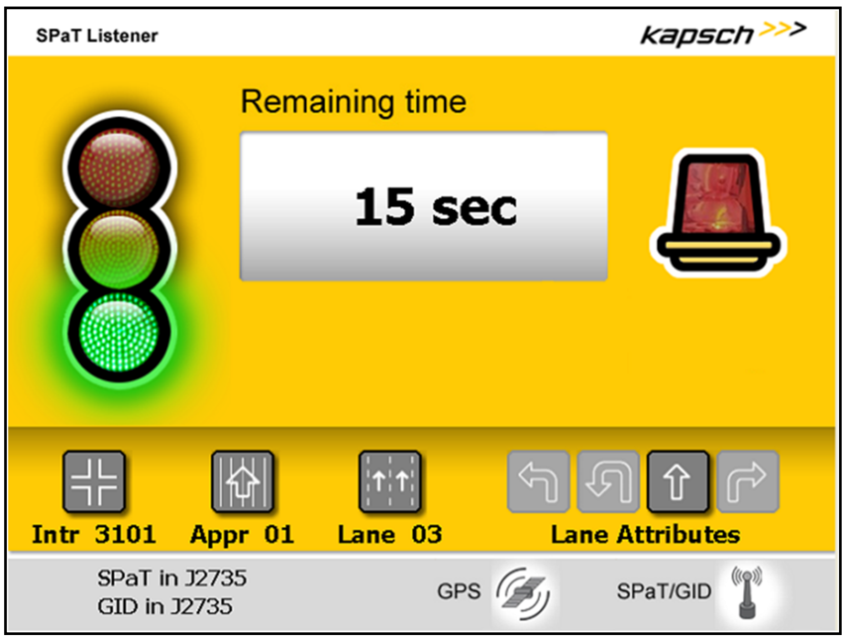
- **75 center-line roadway miles**
  - Interstate and divided highway: ~32 center-line miles
  - Signalized intersections: ~43 center-line miles

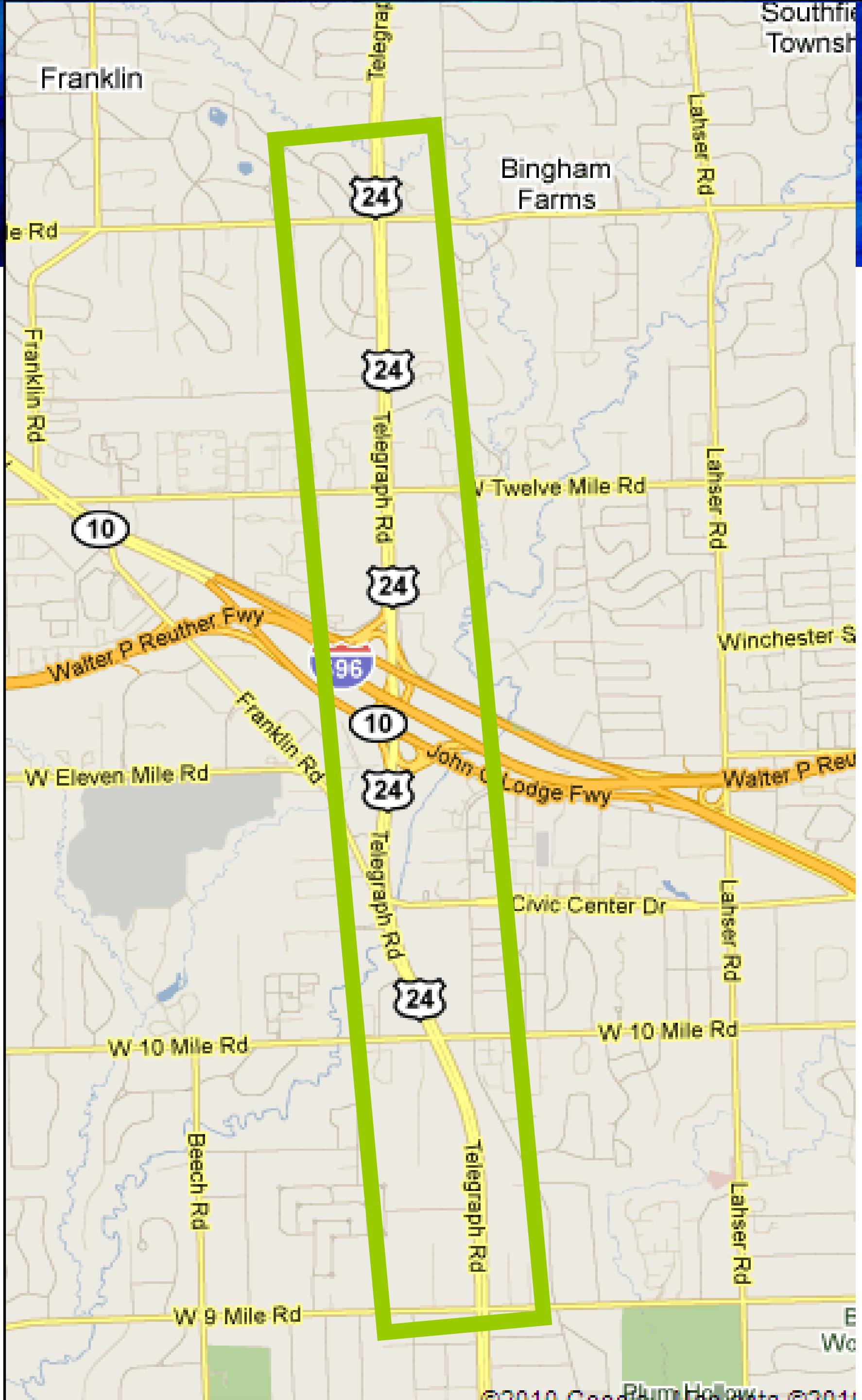
Additional Test Bed Components

- **10 vehicles with On-Board Equipment (OBE)** are available for testers and researchers
- **Service Delivery Node (SDN)** located in the RCOC Traffic Operations Center (TOC)
- **Enterprise Network Operation Center (ENOC)** - additional SDN in SAIC’s Oak Ridge, TN facility

Test Bed Expansion Telegraph Road

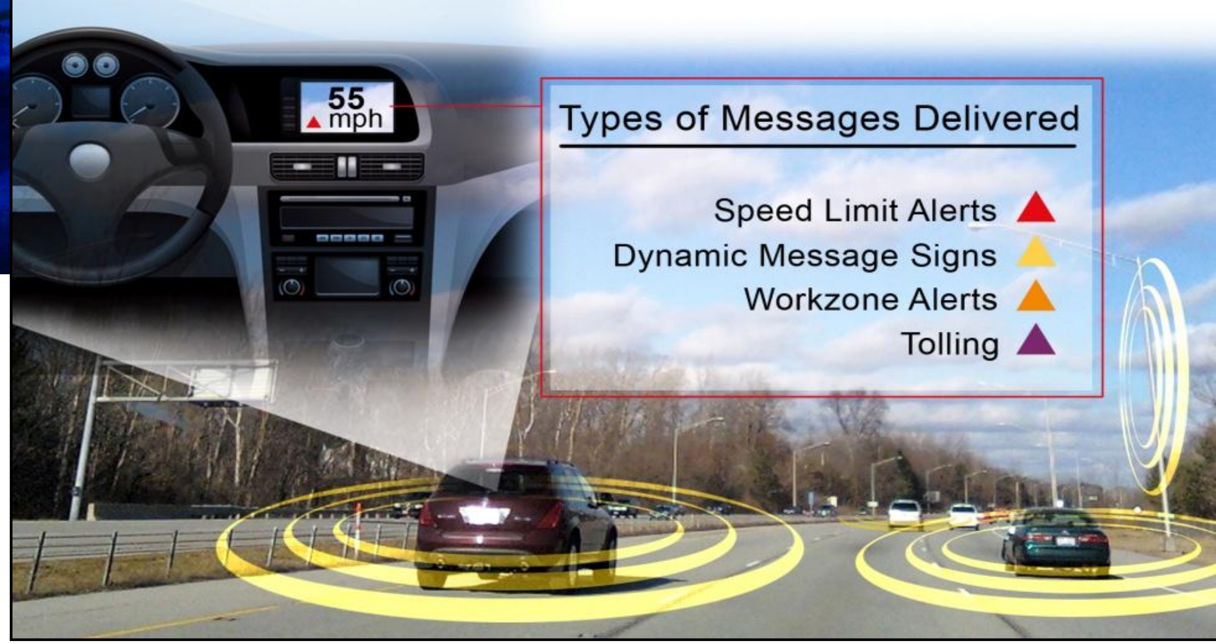
Signal Phase and Timing (SPaT)





Test Bed Capabilities

In-Vehicle Signage

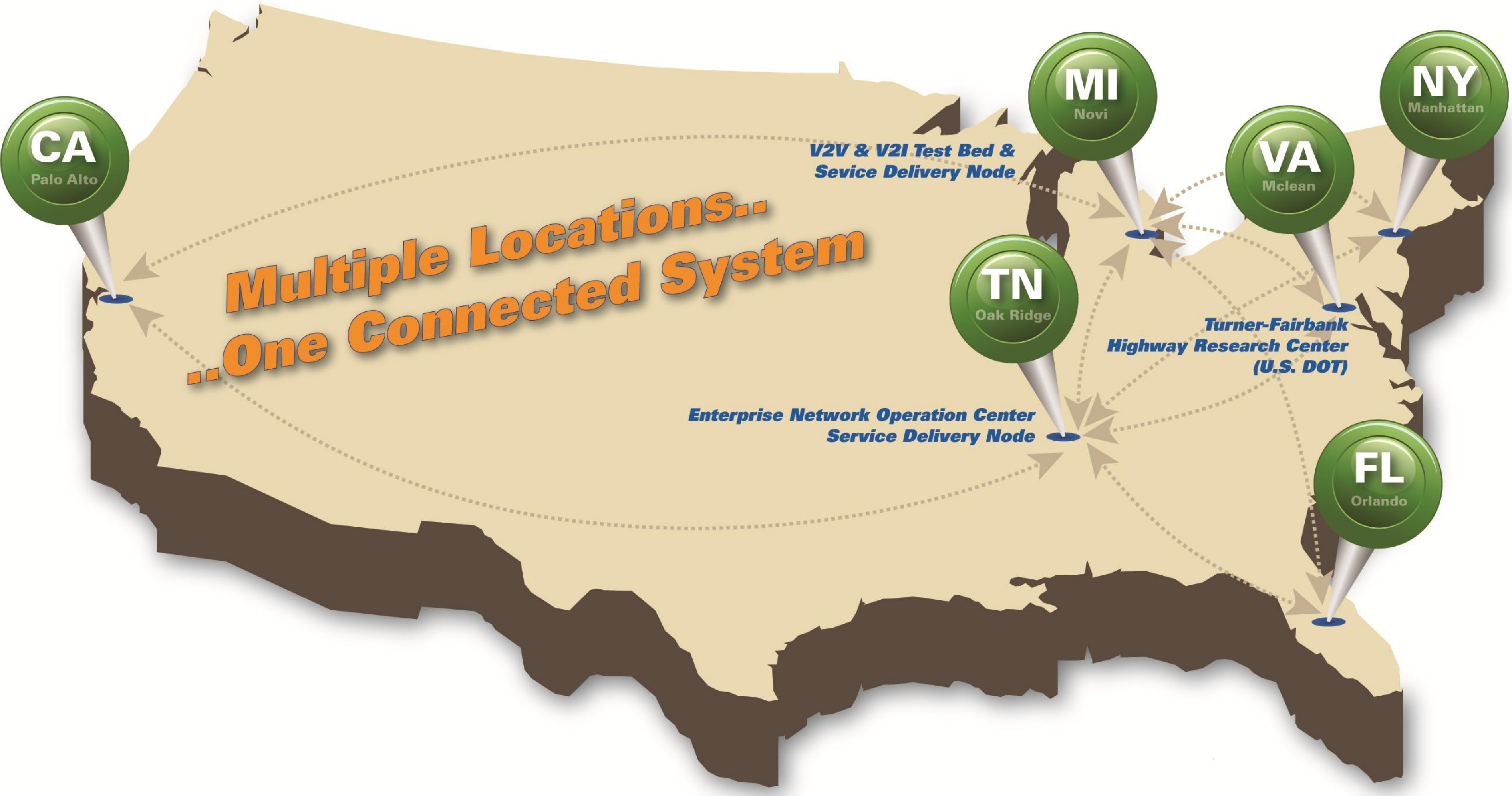


- OBE that stores messages that should be displayed when a vehicle enters a geographic area and tracks the vehicle's position to display messages at appropriate locations
- RSEs that broadcast vehicle messaging data to vehicles and OBE that receives the data and adds new messages to the list of messages that should be displayed
- Back office servers receive requests to post in-vehicle messages from other applications and transmit those messages to the appropriate RSE

More Test Bed Capabilities

- Probe Data Services
- Signal Phase and Timing (SPaT) Services
- V2I Communication Services
- V2V Communication Services
- Tolling Transaction Services
- OBE application hosting
- RSE application hosting

Affiliated Interoperable Test Beds



Expanding the Network

Test Bed of Tomorrow

“Interoperability

- Design new architecture
- Implement a revised System Architecture
- Interoperable components and shared back office services
- Incorporate security processes

18th ITS World Congress Orlando, Florida

- U.S. DOT will be providing support to enable organizations to demonstrate their safety, mobility, and environmental applications and devices at the 2011 ITS World Congress Technology Showcase

- Florida Test Bed will offer the same capabilities as the V2V and V2I Technology Test Bed

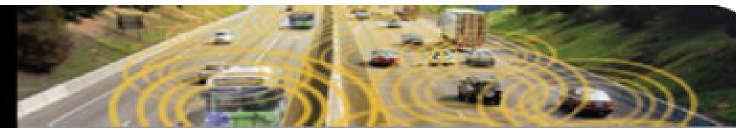
To learn more, visit:

http://www.its.dot.gov/connected_vehicle/technology_testbed2.htm

RITA U.S. Department of Transportation
Research and Innovative Technology Administration

Search

Intelligent Transportation Systems
Joint Program Office



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Updated February 22, 2011 2:14 PM

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RESEARCH

- Connected Vehicle Research
- Mode-Specific Research
- Cross-Cutting Research
- Exploratory Research
- Research Planning
- ITS Research Success Stories

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Connected Vehicle

Vehicle-to-Vehicle and Vehicle-to-Infrastructure Technology Test Bed - Test Bed 2.0

Research Overview

Vehicle-to-Vehicle and Vehicle-to-Infrastructure Technology Test Bed environments are real-world, operational test beds that offer the supporting vehicles, infrastructure, and equipment to serve the needs of public and private sector testing and certification activities.

The vision for the Test Environment research is to establish a minimum of one test bed that can support continued research, testing, and demonstration of connected vehicle concepts, standards, applications, and innovative products. Test environments will also serve as a precursor or foundation for State and local deployments using connected vehicles technologies.

The research will result in the establishment of an accessible V2V and V2I Technology environments (Test Bed) for the public and private sectors to pursue research, testing, and demonstrations of innovative, next-generation ITS technologies. The Test Bed will help establish requirements for future test beds that will provide the State and local foundation for connected vehicle deployment.

- Events of Interest

For more information

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V2V & V2I Technology Test Bed Partners

MDOT
Michigan Department of Transportation

ROAD COMMISSION for OAKLAND COUNTY

SEAL OF THE CHARTER COUNTY OF WAYNE, MICHIGAN 1796

VIIC ONSORTIUM

Caltrans

STATE OF FLORIDA DEPARTMENT OF TRANSPORTATION

New York State Department of Transportation

Update on CAR Connected Vehicle Research for MDOT

Richard Wallace, Director
Transportation Systems Analysis, CAR

May 2, 2011

Forthcoming Products

- Updated *MDOT Strategic and Business Plan for Connected Vehicle Technology*
  - Comes in several parts and will be posted to MDOT web site
- Update to an earlier study (by CAR) on the potential economic benefits of connected vehicle technology to Michigan
- Report on best practices in connected vehicle technology worldwide
  - Includes database of projects, programs, etc.
- Update to *Green and Connected* white paper
  - Previous versions already were available for on both the MDOT and CAR web sites

MDOT's Strategic Plan for Connected Vehicle Technology

MDOT's Connected Vehicle Technology Mission

Lead the nation in connected vehicle research and sustained deployment to improve transportation safety and operational performance and to help establish Michigan as the center of the emerging connected vehicle technology industry.

MDOT's Connected Vehicle Technology Vision

· The Michigan partnership is a recognized leader of and key reason for the success of connected vehicle technology	· Michigan is partnering with other states to assure coordinated research, development and deployment across the United States	·Connected vehicles are an emerging industry with an entrepreneurial foundation that is central to Michigan's strong, new information technology sector
· Michigan is partnering with the automotive industry, including vehicle manufacturers and suppliers, the telecommunications industry, and other industries, and has demonstrated success in researching, developing, and deploying connected vehicle technology	· Test results provide clear, measurable evidence that connected vehicles increases transportation safety, mobility and security · Connected vehicle technology has been accepted enough to be programmed into the annual budgeting of Michigan's transportation needs	· Connected vehicles promise to be one of the biggest advancements in passenger and commercial transportation since the inception of the Interstate Highway System

Customers and Partners

Vehicle Manufacturers and Automotive Suppliers	***Service Providers***	***Universities***	***USDOT***	***State, Local, and Other Federal Agencies***	***Motorists***	***Commercial Fleets and Freight Operations***	***NGOs***	***Transit and Multi-Modal Organizations***

Customer and Partner Needs

Growing Sustainable Deployment	State-of-the-Art Test Facilities	Asset Management	Traffic Management	Safety	Economic Development	Leadership	Financial Support	Cost-effectiveness	Env. Impacts
· Advance research and testing · Initiate and sustain the deployment of a standard, ubiquitous, national connected vehicle infostructure	· State-of-the-art test and development facilities and competencies are core to advancing connected vehicle technologies for manfacturers and suppliers, telematics providers, and Michigan universities	· Data retreival and analysis of Michigan's transportation assets and infostructure are required if transportation assets are to be managed effectively	· Manage traffic and minimize congestion and delays to motorists, commerical fleets, local transportation agencies, the USDOT, and other users	· Reduce the number and severity of vehicle crashes	· Growth in connected vehicle-related jobs and a strong Michigan economy	· National leadership and coordination	· Financial support for advancing research and development in connected vehicle technology	· Provide effective connected vehicle products and services at the lowest cost	· Improved air quality
				· Reduce related property damage and productivity losses	· Facilitate collaboration to work with all the parties involved in connected vehicles	· Promote quality, performance, and national deployment	· Advance the state-of-the-art and practice in wireless technology		· Reduced harmful emissions
· Provide justification and political support for state and national connected vehicle deployment				· Increase overall safety of equipped vehicles	· Contribute to the emergence of a new industry that will create and attract new jobs to the state	· Guide statewide efforts in connected vehicle technology development			

Connected Vehicle Strategic Goals

Partnership	Infostructure	Test Bed	Safety	Traffic Management	Asset Management	Outreach	Justification	Investment	Env. Benefits
Partner with vehicle manufacturers and other stakeholders to coordinate efforts	Lead the nation in designing, testing, and deploying an effective standard for connected vehicle infostructure	Design, implement, maintain, and promote Michigan connected vehicle test and development infrastructure	Advance Michigan-based connected vehicle safety system research, development, and early deployment	Advance Michigan-based connected vehicle traffic management system research, development, and early deployment	Advance Michigan-based connected vehicle asset management system research, development and early deployment	Maintain high visibility of Michigan activities through outreach and public awareness	Justify planned deployment through analysis and research providing evidence of value-added results	Coordinate and leverage Michigan investment and attract federal and international support	Reduce vehicle miles traveled by using smarter mobility

For more information about MDOT's Connected Vehicle Technology Strategic and Business Plan, go to www.michigan.gov/mdotvii

Two Major Technology Trends in the Automotive Sector

- Electrification of the powertrain (HEVs, PEVs, BEVs, etc.)
- Vehicle communications
  - Vehicle-to-vehicle (V2V)
  - Vehicle-to-infrastructure (V2I) and vice versa (I2V)

The Business of Plugging In℠
A Plug-In Electric Vehicle Conference

Image From: Traffic Technology International, June/July 2010

Synergies Created by These Trends

- Simultaneous development of these two technologies is not merely coincidental
- These technologies each make the other better in interesting ways
- Can define at least three dimensions of synergy
  - Transportation Energy Planning and Mapping
  - Grid-Enabled Communication
  - Integrated Energy-Transportation System

Transportation Energy Planning and Mapping

- Limited range of BEVs limits appeal to large number of potential customers
- Vehicle communications can help allay potential driver anxiety by providing drivers with up-to-the-minute info on locations of charging stations within range
- Can also use real-time traffic info to avoid congestion

Grid-Enabled Communication

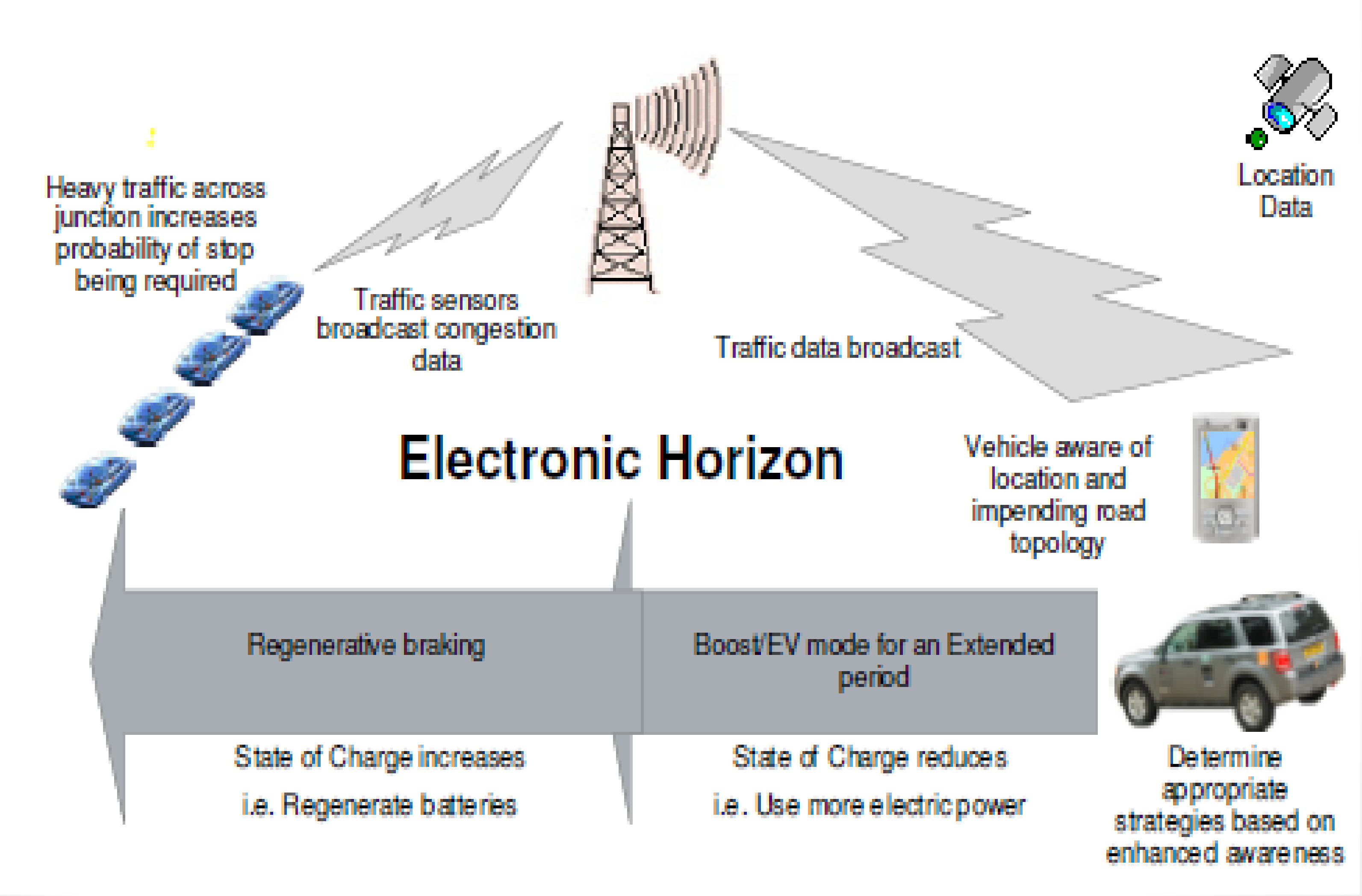
- Links the plug-in vehicle to the home via smart metering
  - On the vehicle or at the charge point
- Use grid-balancing strategies to promote off-peak (and lowest cost) charging
- At times, may even put power back into the grid
  - Challenges remain, however, in maintaining battery life with more charging cycles

Example of Charge Management Tool

Integrated Energy-Transportation System

- Consists of high integration between the energy system and the transportation system
- Uses large fleet of grid-enabled vehicles to manage flow of power, e.g., to meet peak power needs and as a buffer for renewable, but less than 100 % reliable, power generation
- Uses communications to provide considerable situational awareness to the vehicle for optimized powertrain control and management
  - For example, knowledge of upcoming topography or traffic conditions can influence current power consumption, aggressiveness of regenerative braking, etc.

Situational Awareness Optimizes Powertrain Control



Significant Challenges and Barriers

- Infrastructure needs (communications, charging, smart grid)
- Standards (grid and communications)
- Battery cost
- Distracted driving concerns
- Work force needs
- Life after subsidies and incentives

Forces Aligned for Deployment

- Ongoing public- and private-sector investment in green technology
- Like investment in connected vehicle technology
  - Includes 4G, app revolution, etc.
- 2013 NHTSA decision on V2V safety mandate
- Economic recovery

Conclusions

- Green and connected work together synergistically to improve vehicle travel
  - Safety
  - Mobility
  - Environmental performance

Dykema

THE “CONNECTED VEHICLE” – REGULATORY ISSUES AND MODELS

MICHIGAN CONNECTED VEHICLE WORKING GROUP

MAY 2, 2011

DYKEMA
Paul Laurenza
Washington, D.C.

Dykema

Introduction

- Key questions:
  - (1) What is the potential impact of regulation on the substance and/or timing of CVT development or deployment?
  - (2) What recent regulatory experience may provide guidance for possible CVT regulation?

DYKEMA White Paper (Nov. 2010), www.connectedvehicle.org

(“VII Deployment – Regulatory and Non-Regulatory Issues,” April 16, 2009)

Dykema

Introduction (Cont'd)

- Assumption
  - *Safety*, *privacy*, and *security* aspects of CVT would be subject to regulatory oversight at some level or combination of levels (e.g., FHWA 2005 VII papers)
- Reality
  - Implementation = Market forces + industry innovation + government regulation
    - Major safety technologies were available and in limited use *prior to* government safety regulation
    - Many vehicle safety features/systems today "go far, far beyond what the federal government requires …." (IIHS, 4/2010)

Overview of Safety Regulation

- Federal
  - Primarily US DOT function: NHTSA; FMCSA; FHWA
    - NHTSA – Promulgates FMVSS and other regulations by rulemaking (public notice and comment)
      - FMVSS apply only to new vehicles/equipment (OE), with limited exceptions; aftermarket equipment and accessories not covered
      - FMVSS – performance, not design; self-certification; manufacture/importation/sale of non-complying vehicle/equipment prohibited; also, dealers, etc. cannot install any equipment that defeats an FMVSS requirement

Overview – Federal Regulation (Cont'd)

- FMCSA – Incorporation of NHTSA safety regulation plus specialized equipment regulations for commercial vehicles and operator requirements
  - Unlike NHTSA and passenger vehicles, FMCSA may regulate operation of vehicles through commercial driver regulations (e.g., hours of operation, substance abuse)
    - E.g., Anti-texting rule; video display prohibition
    - FMCSA could follow different regulatory track with commercial vehicles

State

- Generally, NHTSA/FMCSA safety regulations preempt any conflicting state regulation
  - States may issue supplemental regulations if not in conflict with federal standards
  - State regulation mainly focused on vehicle use (e.g., operator licensing and restrictions, safety inspections, vehicle registration)
    - State law may impact use of aftermarket devices (e.g., state anti-distraction laws, state privacy laws)

Federal/State "hybrid"

- Federal incentives ("carrot-and-stick") – federal funds tied to states' meeting certain requirements
    - Seat belt enforcement
    - Minimum drinking age
    - Distracted driving (S. 1938)

Dykema

“VII” Primary Safety Applications

- “Day One” cases (VII Working Group 2005)
  - Of 17 original “Day One” V2V/V2I applications, 6 were vehicle/highway safety-related; 8 were traffic information/management; 3 were commercial (electronic payments)
  - Focus was DSRC; safety/non-safety uses/applications have evolved over time
  - Various potential VII safety applications now incorporated in some form in selected current vehicle models via in-vehicle sensor systems
    - E.g., Lane (blind spot) warnings; forward collision avoidance warnings

Dykema

ITS JPO, RITA (April-May 2010):

- V2V is lead safety application
- NHTSA V2V rulemaking decision point – 2013
  - New cars, trucks, buses
  - Unless legislatively mandated time frame, rulemaking period and compliance phase-in are indefinite

Other Communication/Data-Based Recent or Emerging Vehicle Technologies

- E.g., Event Data Recorders (EDR); Backover warning devices
  - Specific issues
    - Regulatory framework (safety)
      - Existing DOT (NHTSA, etc.) regulations do not address CVT
      - Issue regulations to address specific safety issues and preempt conflicting state regulation (e.g., FMVSS)?

EDR – Some Analogous Aspects to CVT

- Background/history
  - Use in other modes (e.g., railroads); increasing use in motor vehicles in 1990's; NHTSA begins use in crash investigations early 1990's
  - NTSB, NASA recommendations – 1997-1999
  - NHTSA EDR working group findings – late 2001
  - Request for public comments – October 2002
  - Proposed rule – June 2004; final rule – August 2006 (more than 50% of 2004 MY vehicles had some crash-recordation capability)

Dykema

EDR – (Cont’d)

- NHTSA regulation does not require EDRs; purpose is to encourage broad application of evolving EDR technologies and maximize usefulness of EDR data
- Regulation specifies required data collection, storage, retrievability, owner manual disclosures if EDR used (not an FMVSS)
  - Preempts conflicting state regulation; other issues (data ownership, privacy, civil/criminal litigation, etc.) left to state law
  - Rejects extension of EDR rule to telematics (ACN, etc.)
  - Proposed legislation (MVSA of 2010) would make EDRs mandatory by 2015 and includes data ownership and privacy provisions

Dykema

Backover Avoidance

- Legislative mandate – SAFETEA-LU requires NHTSA report to Congress on vehicle backover avoidance technology (NHTSA Report Nov. 2006); Cameron Gulbransen Kids Transportation Safety Act of 2007
  - Law required NHTSA within 12 months to begin rulemaking to amend FMVSS 111 (rearview mirrors) to expand required rearward field of view for all vehicles less than 10,000 GVWR
    - Allows (1) different requirements for different vehicles; and (2) different technologies – mirrors, sensors, cameras, etc.
    - NHTSA to determine compliance phase-in, with full compliance within 48 months after final rule issues; phase-in period may be specific to vehicle categories

Dykema

Backover Avoidance (Cont'd)

- NHTSA Federal Register Notice – Mar. 4, 2009
  - Advance Notice of Proposed Rulemaking (ANPRM)
  - NHTSA solicits comment on "wide variety of means to address the problem"
- NHTSA FR Notice of Proposed Rule – Dec. 7, 2010
  - Requires rear imaging systems (camera and video display)
  - Phase-in starting Sept. 2012 to full compliance Sept. 2014
- Issue: Enabling vehicle/driver to "see" non-visually beyond vehicle/vehicle surface. Same issue raised with other collision-warning/avoidance situations (lane change, forward collision)

Backover Avoidance (Cont'd)

- Key regulatory points of backover avoidance effort:
  - Regulatory action required by Congress within fixed time frame
  - Agency to proceed via normal rulemaking process
  - Does not require specific technology or method
  - Recognizes need for phase-in, but sets full compliance period
  - New vehicles/original equipment only

Dykema

Challenges for CVT Safety Regulation

- No closely analogous motor vehicle regulatory model for cooperative vehicle safety systems
  - Safety benefits require "connecting" all makes and models with each other and (possibly) infrastructure (depending on applications)
- Which uses/applications to require or otherwise regulate? How will regulatory scheme address expansion for other safety applications?
  - EDR approach – i.e., regulate elements, but do not require installation – does not fit CVT safety objective because of vehicle interdependence requirement
  - How will availability of in-vehicle safety systems (e.g., lane change, forward collision warnings/crash avoidance systems) impact CVT safety analysis; may affect CVT regulatory cost-benefit analysis

Dykema

Challenges (Cont'd)

- Safety standards generally address new vehicles and equipment, not aftermarket
  - Exceptions: E.g., child safety seats – must meet FMVSS requirements
  - Certification methods?
- CVT should not increase driver distraction, driver overreaction response; partial knowledge base from existing vehicle controls/displays and newer warning technologies (e.g., lane change). How much to leave to owner instructions/warnings?
- How to address issues of privacy and security of data – Federal privacy requirements as in proposed MVSA EDR provisions?
- Consistency with existing FMVSS (e.g., FMVSS 101 – Controls and displays)

NHTSA Vehicle Safety Rulemaking/Research Priority Plan - 2011-2013 (Mar. 2011)

- Connected Vehicles – Large Benefit – Rulemaking decision 2013
- Distraction - Large Benefit –Visual manual distraction guidelines 2011
- Forward Collision Warning/Crash Avoidance - Large Benefit – Rulemaking decision 2011
- EDRs – Other Significant Project – Notice of Proposed Rulemaking 2011
- Lane Departure Prevention - Other Significant Project – Identify effective advanced safety technologies 2011

Other Transportation (Non-Motor Vehicle) Regulatory Models?

- Maritime (Coast Guard)
  - Vessels required to have Automatic Identification System (AIS)
    - Autonomous, continuous exchange of navigation information, ship-to-ship/ship-to-shore, on vessel type, position, speed, course, etc.
    - Based on international standards and protocol
    - Focus is maritime safety and security

Rail (Federal Railroad Administration)

- Positive Train Control (PTC) systems – train-to-infrastructure collision/derailment avoidance
- Lengthy private/public history:
  - Various efforts and federal recommendations (NTSB, FRA) in 1980’s
  - 1994 – FRA report to Congress for PTC action plan; $40 MM funding for PTC development, testing, pilot deployment
  - 1999 – PTC Working Group defines core PTC functions
  - 2004 – FRA report to Congress – costs too excessive to warrant “immediate regulatory mandate for widespread PTC implementation”

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Rail – (Cont'd)

- 2005 – FRA issues rule for technology-neutral performance standard for automatic train control; railroads continue efforts to develop PTC systems on their lines and interoperability
- Oct. 2008 – Reacting to major train collisions, Congress passes Rail Safety Act, requiring mandatory, accelerated installation of approved PTC on commuter lines and Class I freight lines by 2015
- Jan. 2010 – FRA issues final rule for PTC deployment; some federal funding
- Numerous rail pilot projects underway to develop information and experience to assist in meeting 2015 deployment date

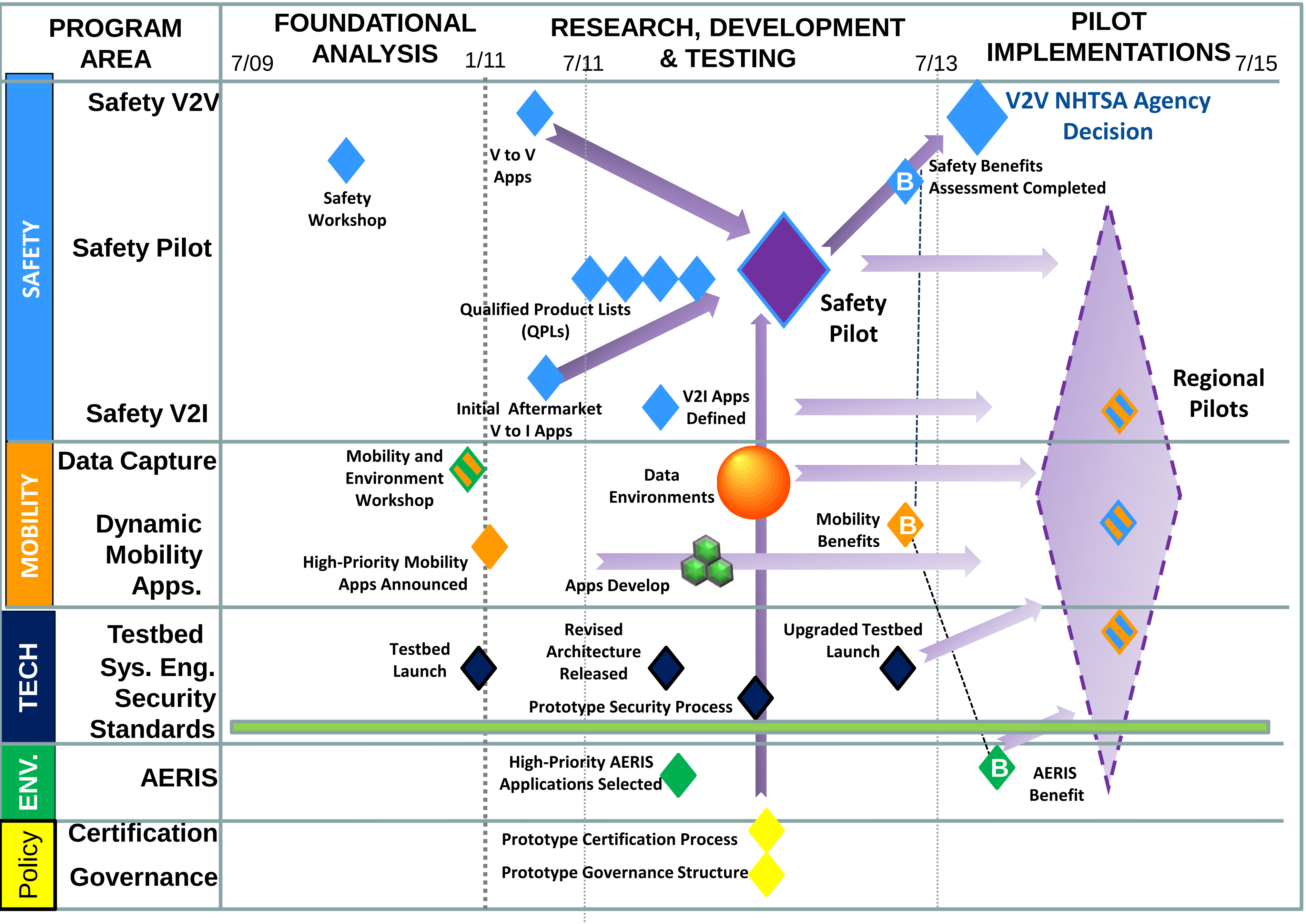
The Challenge

Thank You!

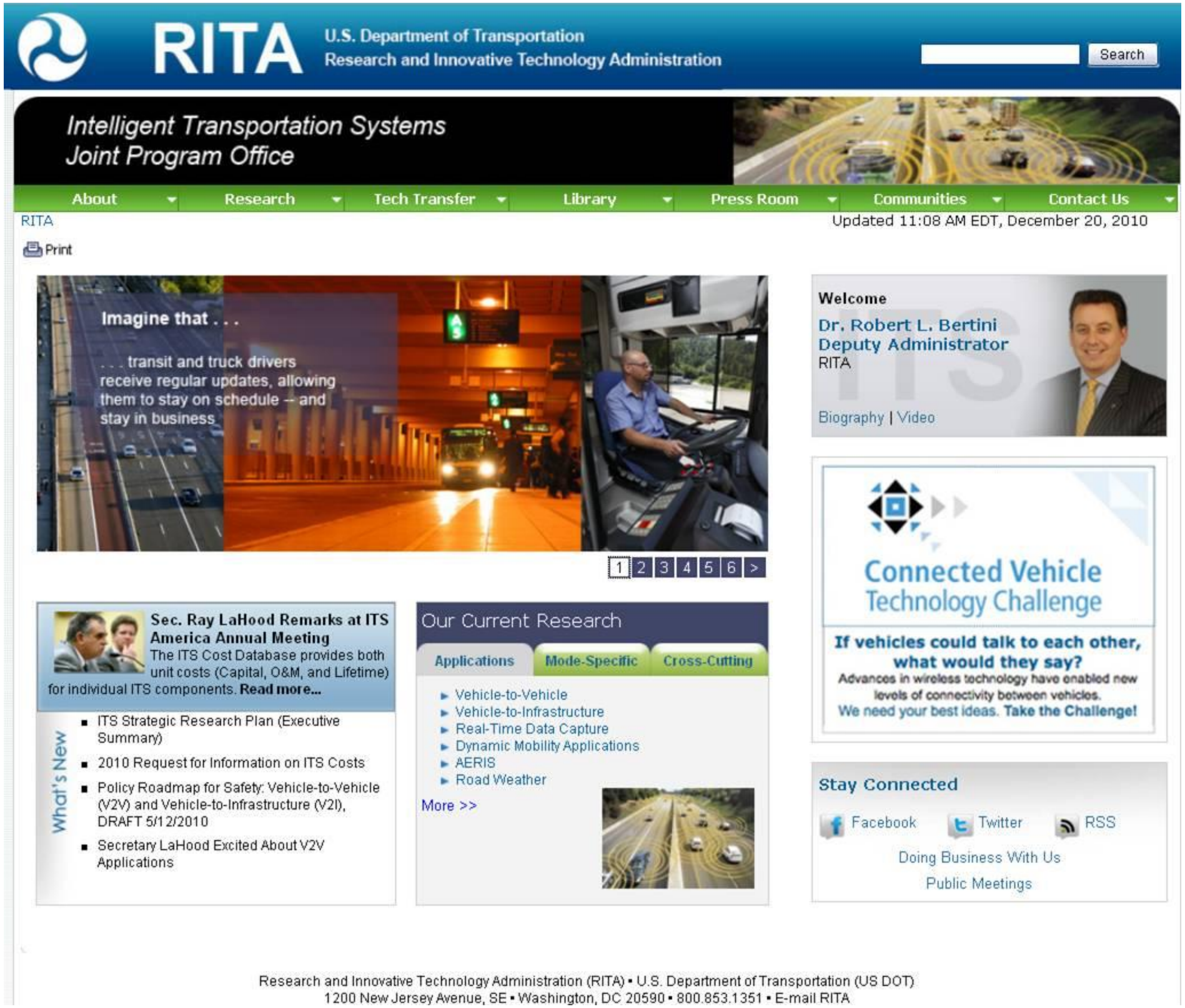
Upcoming Federal Procurement for Connected Vehicle

- V2V Safety Pilot Program – USDOT RITA
- Dynamic Mobility Applications (DMA) – USDOT RITA (fall 2011?)
  - – Three phases, Six tracks over 5-years, including Program Support
    - Stakeholder Engagement
    - Mobility Application Research and Development
    - Proof of Concept Tests
    - Demonstrations
    - Evaluation and Performance Measures
    - Outreach and Technology Transfer
- RFI for FHWA Transportation Operations Laboratory and Research Partners – FHWA Turner-Fairbanks (May 13, 2011)
  - – Data Resources Testbed
  - – Concepts and Analysis Testbed
  - – Cooperative Vehicle-Highway Testbed
- Connected Vehicle Technology Challenge – USDOT RITA
  - – New applications, devices, products, services, business solutions, and operational concepts based on DSRC (May 1, 2011)
- www.its.dot.gov

Major Milestones



For More Information



www.ITS.DOT.GOV

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Connected Vehicles @ UM-D

On Campus

- Research and industry collaboration offices
- Ph.D. Programs (~30 candidates/~30 faculty/staff)
    - Automotive Systems Engineering
    - Information Systems Engineering
- CV/EMC Laboratory
- Wireless communications laboratory
- Integration laboratory and garage

Off Campus

- 9 Mile Intersection public road laboratory
- UM Open Ranges
- Michigan Test Bed (Ford)

Connected Vehicle Tour

- CAST Lite, Randy Motyka
- Traffic modeling and speed and profile prediction, Yi Lu Murphy
- DTE Power Electronic Lab, Yan Yang
- DSRC prototyping and simulation, Weidong Xiang